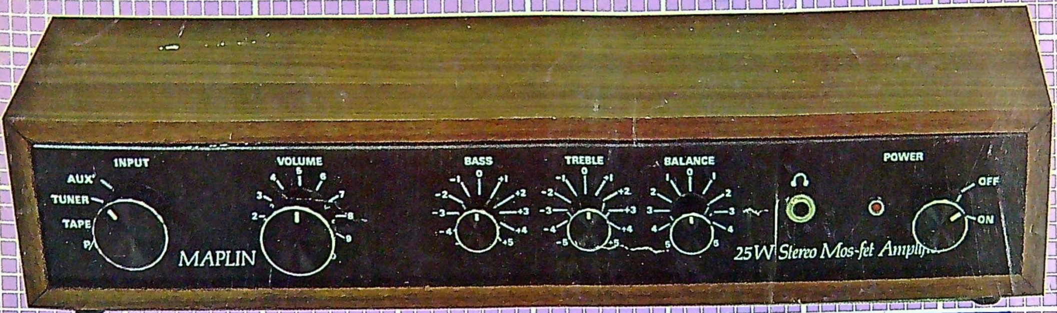
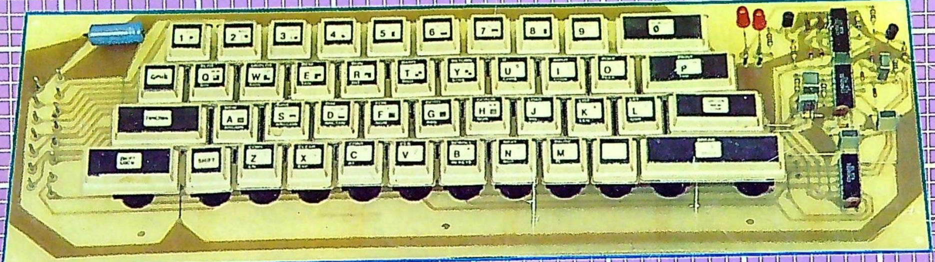
JUNE-AUGUST 1982 PRICE 60p

Electronics
THE MAPLIN MAGAZINE



SUPERB 25W PER CHANNEL RMS STEREO AMPLIFIER WITH RELIABLE MOSFET OUTPUT STAGE IS SO EASY TO BUILD



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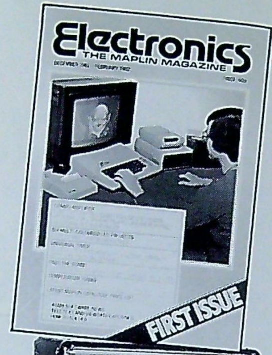


Copies of issue 1 are still available for just 60p, and include all these interesting projects:

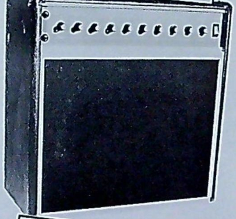
Universal Timer. A comprehensive programmable controller for up to 4 mains appliances. There is storage for up to 18 program times, ons or offs and relay outputs. Complete construction details.

Combo Amplifier. Superb 120W MOSFET power amp with low-noise BI-FET pre-amp having built-in flanger, inputs for guitars, keyboards or microphones, and five step equaliser. Complete construction details.

Temperature Gauge. Coloured LED indication of -10°C to 100°C. Complete construction details.

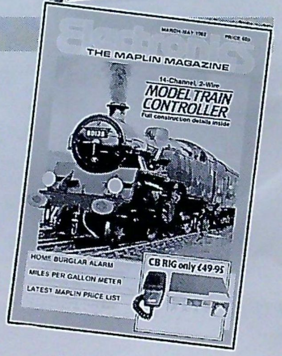
Pass The Bomb! Low-cost easy to build electronic version of pass-the-parcel — keeps the kids amused for hours!

Plus six easy to build projects on Veroboard: Car Battery Monitor — Colour Snap Game — CMOS Logic Probe — Peak Level Indicator — Games Timer — Multi-Colour Pendant.



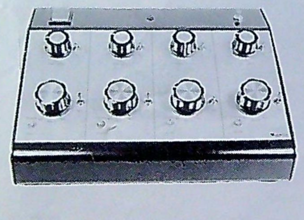
Issue 1 also included features on Videotext and How To Solder and feature series, Basically BASIC, Starting Point and Circuit Maker.

All this for just 60p. Order As XA01B (Maplin Magazine Volume 1 No 1) Price 60p*NV*



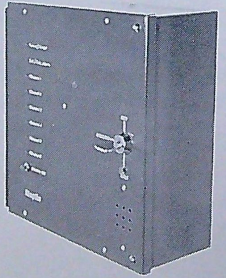
Copies of issue 2 are also available for just 60p and include the following projects:

Digital Multi-Train Controller. Our superb digital train controller can control up to 14 locomotives individually on the same track. Any four loco's can be controlled simultaneously. The unit has automatic short-circuit protection and because it uses digital control a DC supply is present all the time for carriage lighting etc. The locomotive modules will fit in most modern 00-scale engines. Complete construction details.



Multi-Mode Digital Stopwatch. Here's an easy-to-build stopwatch with accuracy and display to a 100th of a second. There is a large 8-digit display so that times of up to 24 hours can be shown. The unit can be operated in one of four modes: standard, sequential, split and rally. Complete construction details.

Home Security System. Full construction details of our new home security system offering a high degree of protection for domestic or commercial premises coupled with excellent long-term reliability. The unit's features are: six independent channels, 2-wire or 4-wire operation, detects open or short circuit or just resistance change, tamper-proof main cabinet and external cabinet. The external cabinet has its own protection as well. There are presettable entry and exit delay timers. With the extra peripherals being added each issue, this is a really versatile system.



Digital M.P.G. Meter. An easy to build device that will help you to make your motoring more economical. The unit has a large easy to read LED display. Complete construction details.

Issue 2 also included features on CB Equipment, Working with Op-Amps Part 1 and our regular feature series: Basically BASIC, Starting Point and Circuit Maker, Plus news of the Atari computer and video games, a small feature on solar cells and lots more.

All this for just 60p. Order As XA02C (Maplin Magazine Volume 1 No 2). Price 60p*NV*

Electronics
THE MAPLIN MAGAZINE

INTEREST FREE CREDIT ON COMPUTER HARDWARE

In this issue we're pleased to announce details of an exciting new scheme. If you want to buy over £120-worth of computer hardware, we can now offer you nine months to pay — interest free! All you pay is 10% of the cash price when you collect the goods, then 10% a month for a further nine months. You end up having paid only what you'd have paid had you bought it cash, but with the payments spread over 9 months. Now you can afford today, the computer you always wanted, without having to pay crippling hire purchase charges. With our scheme there are no charges at all! At the present time we're planning to run the scheme until the end of August '82, but we will extend it if it is very successful.

Talking of success, we still can't believe how many subscriptions we've received for this magazine. Though I must apologise for disappointing you by having to hold over promised articles. Last time we didn't have space for the sequencer, so we've now published this as a leaflet (see page 5) and this time with much regret, we have to hold over the frequency counter, even though we are certain it will be very popular. Its unique digital switching system makes it unbelievably simple to use.

Finally, a plea to please keep your letters coming. In this issue we were able to print *every* letter received. Usually we are able to choose from about 50 or 60. It's hard to believe that we totally please our customers for every one of the 50,000-plus orders we despatch every quarter. So if you can think of ways we could improve our service then please do write. Even if we don't publish your letter, you can be sure that all the directors at Maplin read and take note of what you have to say. We may well not agree with what you say, but we're happy to throw open the discussion through these pages.

As usual, we're well-advanced with the projects for the next issue — some really interesting things too, as you'll see if you take a look at the inside rear cover. Many of the projects for issue 5 are also well-advanced and we're really excited about a unique new service we're hoping to launch with issue 5. The Maplin Magazine is always original and up-to-date. Don't miss it — send your subscription now!

June to August 1982 Vol. 1. No. 3

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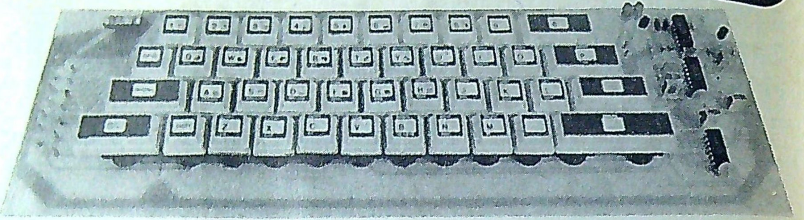
FULL~SIZE KEYBOARD

Complete kit ONLY £19.95 case extra

FOR ZX81 MICRO-COMPUTER

by Dave Goodman



- ★ **Single key selection of Graphic symbols, Function mode and Shift Lock**
- ★ **Full size, full travel, 43-key keyboard**
- ★ **Two-colour legend for keys is the same as the ZX81 keyboard**
- ★ **Faster, more reliable entry — use it once and you won't be able to do without it again!**

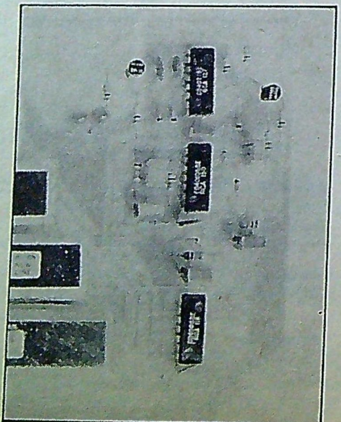
Support systems for the Sinclair ZX81 are very much in demand at the moment and an add-on keyboard with full size keys can offer a great improvement over the existing unit. Operation becomes more positive, unlike the ZX81's touch-keyboard where the only way to be sure you've pressed the key correctly is to check on the screen. With this keyboard, the feel is similar to that of a typewriter and thus entry speed is far higher and much more reliable.

On the ZX81's touch-keyboard, to select a graphic symbol — first the "shift" key must be operated and held and then the "graphics" key operated, then the "shift" key held and the actual graphic symbol required pressed. On this keyboard simply press and release the "graphics 2" key. An LED gives an indication that the mode is selected and the screen cursor changes to [G] as normal. Now any desired graphics symbol may be selected directly without pressing or holding any additional keys. Press and release "graphics 2" key again to return to normal mode. The LED will extinguish and the screen cursor will return to [K or L].

On the ZX81's touch-keyboard selecting a function requires a similar operation to selecting a graphics symbol. On this keyboard simply press and release the "function" key. The screen cursor changes to [F] and an LED flashes once to indicate that this mode is selected. Now any of the operator keys may be selected directly without pressing or holding any additional keys. After selection the LED is extinguished and the screen cursor returns automatically for normal entry.

Finally, this keyboard has a "shift lock" key that electronically holds the keyboard in shift mode after that key is momentarily pressed. A second LED lights to indicate that this mode is selected. Pressing the "shift lock" key again, extinguishes the LED and returns the keyboard to normal entry mode.

Our own experiments have proved that this keyboard is invaluable. No-one who tried it wanted to go back to using the touch-keyboard. Relief from neckache was one often cited advantage! Users described how with the touch-keyboard one looks down to the left or right to read the program to be entered, then at the keyboard to select the key, then up at the TV to check the symbol has gone in, then often, back to the keyboard to roll the finger around a little more because the symbol hasn't been entered (apparently a common occurrence), then up to the TV again, then back to the program. When entering with our keyboard, operators rarely needed to move at all.



Children who used it, found they could perform complicated operations easily — often they could not do the same thing on the touch-keyboard at all! Everyone agreed that there was no alternative on the market and almost lynched the author to get their hands on the prototype.

S1 = 1
S2 = 2
S3 = 3
S4 = 4
S5 = 5
S6 = 6
S7 = 7
S8 = 8
S9 = 9
S10 = 0
S11 = Grps 2
S12 = Q
S13 = W
S14 = E
S15 = R
S16 = T
S17 = Y
S18 = U
S19 = I
S20 = O
S21 = P
S22 = Func'
S23 = A
S24 = S
S25 = D
S26 = F
S27 = G
S28 = H
S29 = J
S30 = K
S31 = L
S32 = New Line
S33 = Shift Lock
S34 = Shift
S35 = Z
S36 = X
S37 = C
S38 = V
S39 = B
S40 = N
S41 = M
S42 = ·
S43/44 = Space

Table 1. Key function chart.

Construction

Begin by straightening and forming the wire links of which there are thirty. These must be fitted first. Then fit the six diodes, taking care to align the black band printed around the body with the white line printed on the pcb. Insert all the resistors. For those unfamiliar with the colour code, a chart is printed in the resistor section of our catalogue or you can use the Colour Wheel (XL05F).

Next fit the three IC's taking care to ensure that they are the right way round and that all the pins come through the pcb. Polycarbonate capacitors are easily recognised by their silver bodies. They fit directly on to the pcb, but if the legs have been bent, take care when straightening as they are easily broken. Fit the four little disc ceramic capacitors and then the axial electrolytic. With this component ensure that the indent around the body of the capacitor is at the same end as the '+' sign printed on the pcb. Finally fit the two transistors so that their 'D' shaped package aligns with the 'D' shape printed on the pcb. Push them down to about 0.5 to 1cm (¼in) from the pcb surface.

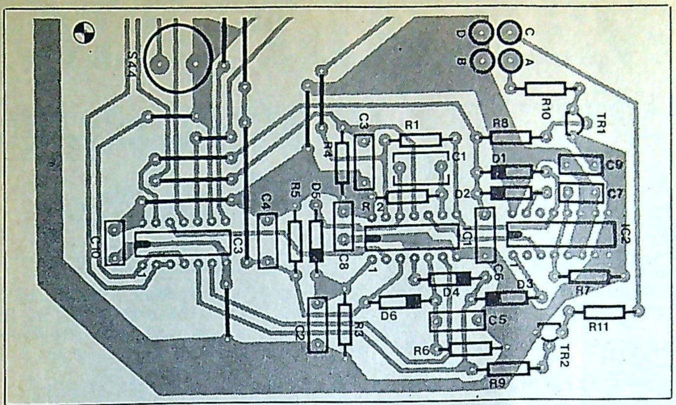


Figure 1. Component overlay of electronics section of pcb.

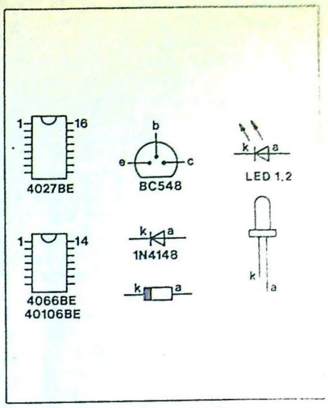


Figure 3. Pin-outs of components.

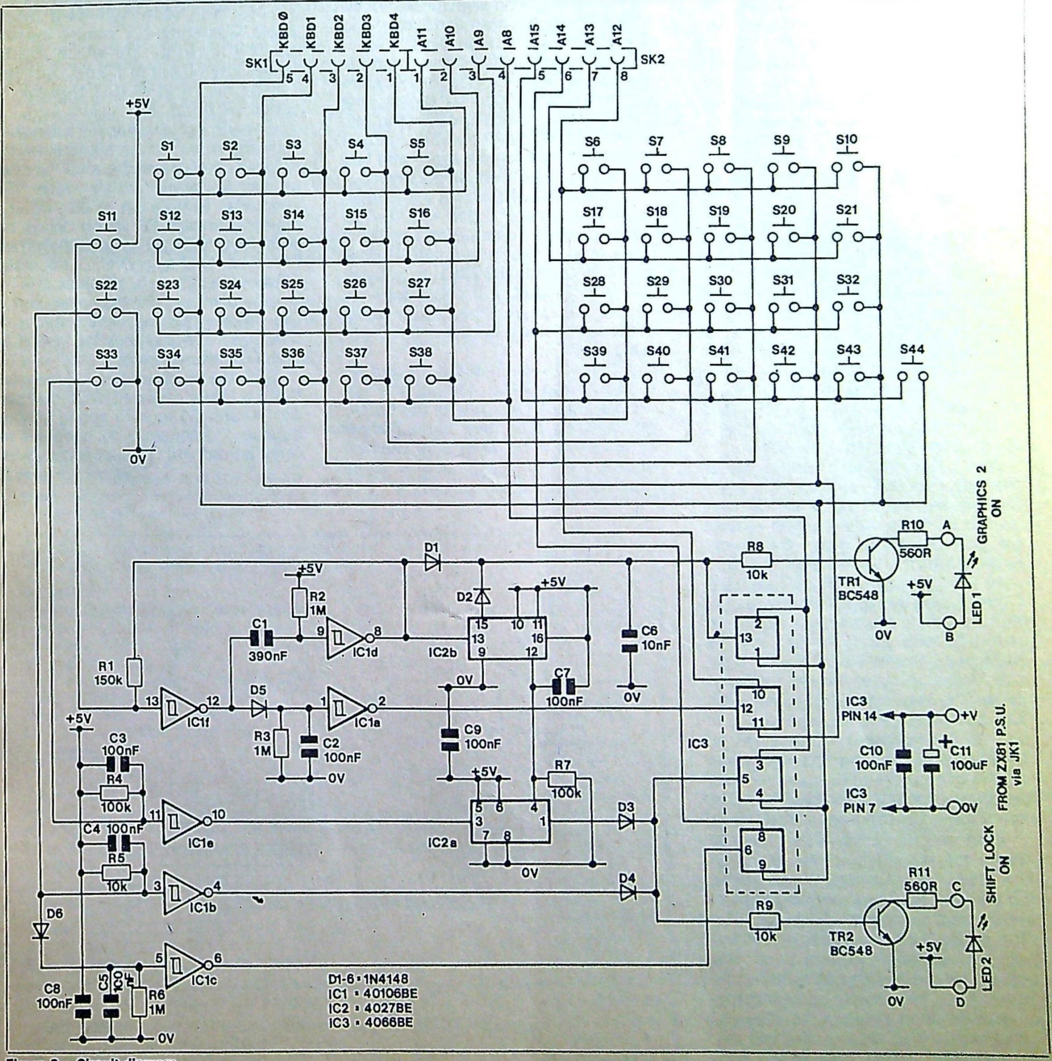


Figure 2. Circuit diagram.

ZX81 KEYBOARD

Carefully solder all the components and links inserted so far, then fit the 44 key-switches in position. Place a piece of stiff card on top of the keys, then turn the whole assembly over and solder the keys in position. Make sure that every key is seated right down on the pcb and re-solder if necessary.

Check the pcb for solder splashes, dry joints etc, then double-check the position of every component and check that the polarised components (C11 and all semiconductors) are correctly orientated. Fit and solder the two LED's either externally with two lengths of wire or directly to the pcb. If using our case then the height of the two LED's will have to be carefully adjusted. See Figure 3 for details of lead connections to the LED's. Finally fit and solder the two sockets to the edge of the pcb.

Fit the white plastic caps to the keyswitches noting that two-position caps must be fitted in the 'rubout', 'print', 'newline', 'function' and 'shift lock' positions, and the three-position cap must be fitted over the two keys in the 'space' position. See Figure 4. Carefully cut the printed legend and fit the pieces into the clear caps referring to Table 1. Then turn the transparent covers over and snap them into position on the keys.

Connecting To ZX81

Careful inspection of the two flexible cables will show that at each end a small strip of the insulating cover has been removed one side of the cable. Plug the two cables into the sockets on the keyboard pcb so that this uninsulated strip faces the pcb. Carefully remove the feet on the ZX81 and unscrew the screws beneath them. Remove the base from the ZX81.

Push the two new flexible cables through the slot in the ZX81 case immediately above the '9' and '0' keys on the touch-keyboard. Then remove the five-way cable (from the touch-keyboard to the socket on the ZX81's pcb) from the socket. With reference to Figure 6 plug the new 7-way cable in so that the black stripe on the cable corresponds with pin 1 of SK1 on the Keyboard pcb and KBD4 on the ZX81 pcb. Repeat this operation for the 8-way cable. The black stripe on the new 10-way cable corresponds with pin 1 of SK2 on the Keyboard pcb and A11 on the ZX81 pcb. Note that the new cables are 7-way and 10-way to ensure correct mechanical fit, though in each case the outer two wires are not used electrically.

Strip and tin (apply a thin layer of solder to) the ends of the piece of screened cable. Connect one end to the 3.5mm jack plug as shown in Figure 5 and connect the screen at the other end through the hole (from above) on the pcb marked '0V' and solder under the pcb. Connect a multimeter switched to 10mA DC range or thereabouts with the positive lead connected to the unterminated centre lead of the cable and the negative lead to the track on the pcb immediately beneath the hole marked '+V'.

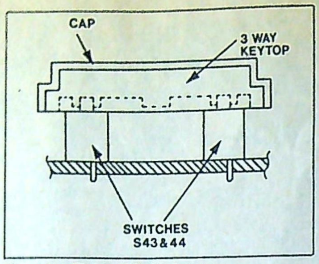


Figure 4. Fitting of 3-way key cap.

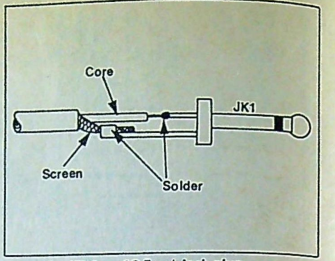


Figure 5. Wiring of 3.5mm jack plug.

Plug the adaptor into the ZX81 and plug the mains adaptor into one of the two sockets. Plug the keyboard into the other socket and switch on. LED1 should flash on and then off and the meter should then read less than 1mA. If the meter reads negative or greater than 1mA switch off immediately and re-check all your connections.

If all is well, switch off, remove the multimeter and connect the centre conductor to the pcb by passing the bare end through the hole in the pcb marked '+V' from above and soldering it underneath. Switch on again and test that the keyboard functions correctly.

If the wrong characters are printed you have probably got the flexible cables plugged in the wrong way. Don't worry, this can't do any damage. Unplug the 7-way cable in the ZX81, turn it over and plug it in again. If it still does not work do the same for the 10-way cable. If this does not work, reverse the 7-way cable again.

When all is well, switch off and re-assemble the ZX81, folding the old flexible cables back under the touch-keyboard so that they cannot short anything out on the ZX81 pcb. The new keyboard can now be mounted in its box if required. Switch on again. LED1 will flash on and then off and the [K] cursor should appear on the TV screen as usual and you're ready to go.

Circuit Description

S11, the 'graphics 2' key is connected to a buffer/inverter IC1f which together with IC1d acts as a monostable. Operating S11 causes the output of IC1f to go low which in turn causes the output of IC1d to go high, holding the input of IC1f high for the period set by C1, R2.

The output of flip-flop IC2b now goes high and turns on the bilateral switch IC3a which operates the 'shift' function in the keyboard matrix. Also TR1 conducts, turning on LED1. C2 discharges through R3 which delays the output from IC1a from changing state. When it does change over IC1a operates IC3d which connects 'graphics 2' in the keyboard matrix. Further operation of S11 repeats this sequence except that this time IC2b switches low and IC3a and IC3d are released.

S22, the 'function' key is connected to IC1b. When operated, IC3b operates via D4 with C4 and R5 acting as anti-bounce components. D6 becomes reverse biased and C5 discharges via R6,

Continued on page 55

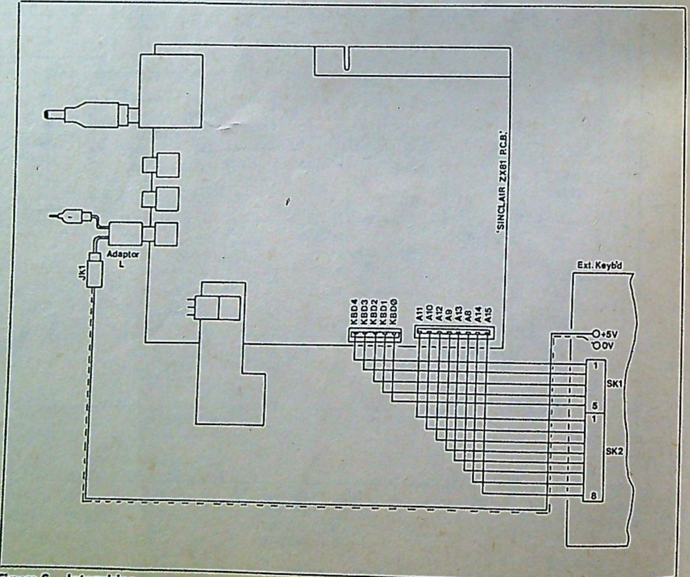
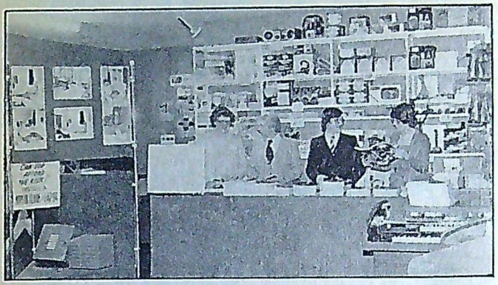


Figure 6. Interwiring.

MAPLIN NEWS

MAPLIN AT THE DAILY MAIL IDEAL HOME EXHIBITION



The "Daily Mail" Ideal Home Exhibition that was at Earls Court Exhibition Centre during March attracted over ¾ million people. Many of them visited our stand where our organ was on demonstration. The Atari computers were also being demonstrated and many of our more popular lines were available for sale. Several thousand leaflets describing our new burglar alarm were taken by interested visitors.

BREADBOARD 1982

Last year's Breadboard exhibition was not as successful as we would have hoped. The gate was well down on the year before and the swingeing increase in the entrance fee upset many people who came onto our stand to complain. The organisers did almost nothing in our opinion to justify to the visitors, the cost of the entrance fee. We therefore feel that we can no longer support this function and Maplin will not be exhibiting at Breadboard 1982.

At the present time we are negotiating with another organiser, a new and better hobby electronics show, with computing and amateur radio thrown in. If all goes well, the new show will happen in December this year. More news in our next issue.

SEQUENCER FOR 5600S & 3800 SYNTHESISERS

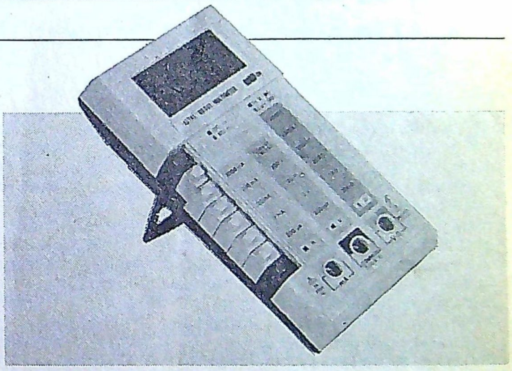
We regret that again there was insufficient space to include this project in the magazine. Therefore we are making it available on a leaflet which is available now.

Order As XH59P (Sequencer Leaflet) No charge

The complete kit will also be available shortly.

Order As LW66W (Sequencer Kit) Price £125

DIGITAL MULTIMETER



This incredibly low-priced meter is attractively styled in a two-tone brown plastic case with a tilt stand and front panel printed in five colours for easy function identification. The easy-to-use push-button range selectors permit one hand operation. Now just look at this incredible specification.

Specification:

General
Display: 3½ digit LCD with auto-zero and auto-polarity.
Operating temperature: 0°C to 50°C
Storage temperature: -35°C to 65°C, battery removed
Low battery indicator: "LO BAT" appears on display during last 20% of battery life
Weight including battery: 400g
Size: 170 x 89 x 38mm.
Calibration adjustment: 3 readings per second.
Accuracies are ±.(% of reading + no. of digits).

DC Voltage
Ranges: 200mV, 2V, 20V, 200V, 1000V
Resolution: 100uV on 200mV range
Accuracy: 0.5% + 1 digit
Input impedance: 10MΩ
Normal mode rejection: >60dB at 50Hz
Common mode rejection: >100dB at DC and 50Hz
Response time: <1 second
Overload protection: 63mA fuse

DC Current
Ranges: 200uA, 2mA, 20mA, 200mA, 2A
Resolution: 100nA on 200uA range
Accuracy: 1% + 1 digit on 200uA, 2mA and 20mA ranges, 2% + 2 digits on 200mA and 2A ranges
Burden voltage: 200mV max at full scale except 700mV on 2A range full scale
Response time: <1 second
Overload protection: A pair of fast switching, high current silicon diodes and a 2A fuse

AC Voltage
Ranges: 200mV, 2V, 20V, 200V, 750V
Resolution: 100uV on 200mV range
Accuracy: 45Hz to 400Hz 1% + 5 digits

Conversion type: Average sensing, calibrated to read RMS of sine wave
Input impedance: 10MΩ <100pF
Overload protection: 63mA fuse

AC Current
Ranges: 200uA, 2mA, 20mA, 200mA, 2A
Resolution: 100nA on 200uA range
Accuracy: 45Hz to 400Hz
3% + 5 digits on 200uA range
2% + 5 digits on 2mA range
3% + 2 digits on other ranges
Burden voltage: 250mV max at full scale, 700mV on 2A range full scale
Response time: <2 seconds
Overload protection: A pair of fast switching, high current silicon diodes and a 2A fuse

Resistance
Ranges: 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
Resolution: 0.1Ω on 200Ω range
Accuracy: 0.5% + 1 digit on 200Ω range, 0.5% + 2 digits on 2k to 2M ranges, 2% + 1 digit on 20M range
Open circuit voltage: Selectable - high <2.8V, low <0.54V
Overload protection: 63mA fuse

In addition to the various overload protection devices described above, the meter has transient protection on all voltage and resistance ranges up to 6kV. Also the input to the AC converter is protected against overvoltage. The meter requires a standard PP3 battery (not supplied), but there is a socket for connecting a 9V adaptor for mains operation and this input is protected against overvoltage.

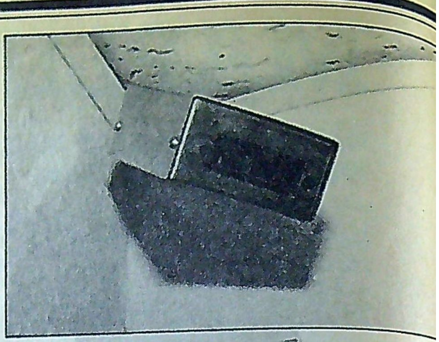
The meter is supplied with a pair of test probes and a circuit diagram.

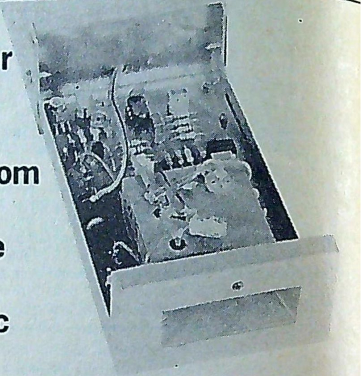
Order As YK32K (Multimeter DD601) Price £39.95

RADAR DOPPLER INTRUDER DETECTOR

THE MAPLIN RTX3

by Dave Goodman





- ★ **Home Office type-approved microwave Doppler detection system with up to 20m range**
- ★ **Single unit covers a wide area**
- ★ **Not susceptible to instability or interference from sound or light**
- ★ **Complete unit in 133 x 70 x 38mm box can be placed anywhere in area to be scanned**
- ★ **Unit may be hidden behind thin card or plastic**

The Maplin RTX3 movement detector utilises a specially manufactured microwave transceiver module, the CL8960. The module is assembled and preset to transmit at the required legal frequency of 10.687GHz ±12MHz (10,687,000,000Hz) with a peak transmission power of 10mW.

The extremely small wavelength (2.8cm) makes a very sensitive movement detector with coverage of quite a large area. In this design the range is adjustable from about 2m to 20m and the edge of the range is fairly well-defined wherever it is set.

The unit when triggered operates an internal LED and switches on a transistor which could switch up to 15V at 1A, but does not latch. Normally the unit will be used with our controller unit to which up to four of the radar modules could be connected. This control unit can then be used to connect to our Home Security System via the standard Break Contact Module. The control interface is described later in this issue.

Circuit Description

The heart of the system is the CL8960 radar module which consists of two tuned cavities or waveguides and a separate antenna which when fixed to the module gives a gain of around 5dB. One waveguide contains a Gunn diode which produces X-band microwave energy. This diode requires an extremely precise and stable power supply which should be 7V ±100mV at 160mA. This is derived from the 12V power supply by IC1, a precision voltage reference IC and two 1% resistors R3 and R4 that monitor the 7V rail. The current is supplied by TR3, an emitter follower driven by TR1. C1 decouples any hf component in the power supply.

The other waveguide contains a mixer diode which acts as a receiver. There is a small hole between the two waveguides so that some of the transmitted signal passes directly to the

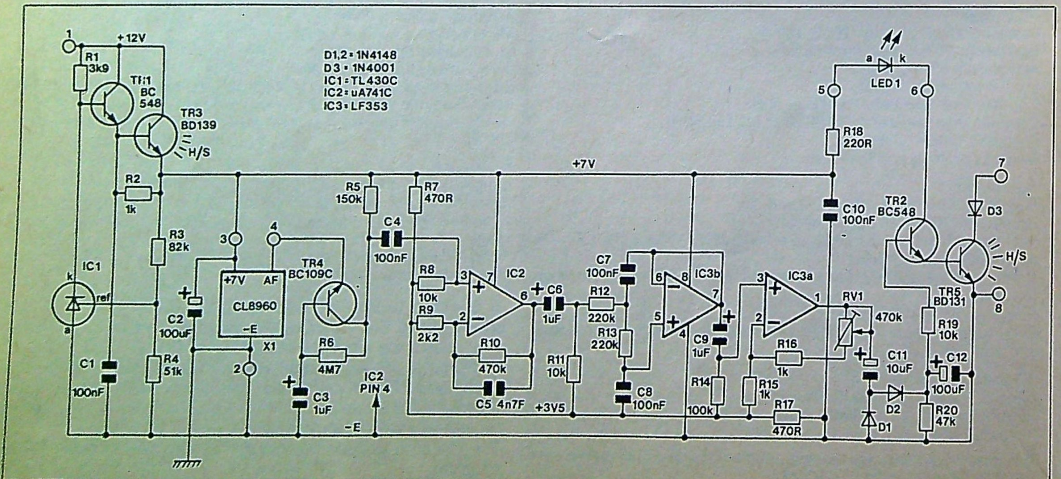


Figure 1. Circuit diagram of Doppler unit.

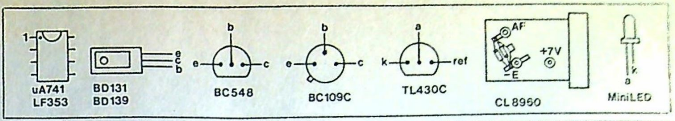
receiver. The reflected signals from the environment are at exactly the same frequency as the transmitted signal as one would expect. However, if an object moves within the sensitive area, the reflected frequency changes slightly due to the Doppler effect (see box). Even a small movement at this extremely high frequency can make changes of up to 50Hz (although of course this is only a minute change in percentage terms — less than 1 part in a hundred million). For example a movement of 1 metre per second will change the frequency by about 70Hz.

This slightly changed frequency will interfere with the transmitted frequency in the receiver cavity and produce a beat frequency equal to the change. This low frequency beat is output from the mixer diode at the terminal marked 'AF'. The mixer diode requires biasing at about 38uA with a low impedance (600Ω), therefore TR4 is required to be a common base amplifier with the bias current supplied by R5.

The AF signal is then AC coupled to IC2, a non-inverting amp and C5 ensures that only low frequencies are amplified. IC3b is a low-pass filter with a cut-off frequency around 40Hz. If higher frequencies are allowed to pass, the unit is prone to false triggering from for example mains-operated lighting, especially fluorescent lamps. The combined filtering in IC2 and IC3b eliminates this possibility.

IC3a is a variable gain amplifier which is preset by RV1 to allow you to adjust the overall receiver sensitivity so that areas from 2m to 20m can be covered reasonably accurately. C11 and 12 and D1 and 2 remove the AC component from the audio signal and provide a DC bias to switch TR2 and LED1. If no further movement is detected, LED1 turns off after about 3 to 4 seconds as set by R20.

Pins 7 and 8 will normally be left unconnected, but if the unit is not being used with our control interface then these two pins can be wired to an external switching system and an external power supply not exceeding 15V at 1A must be used. See Figure 5.



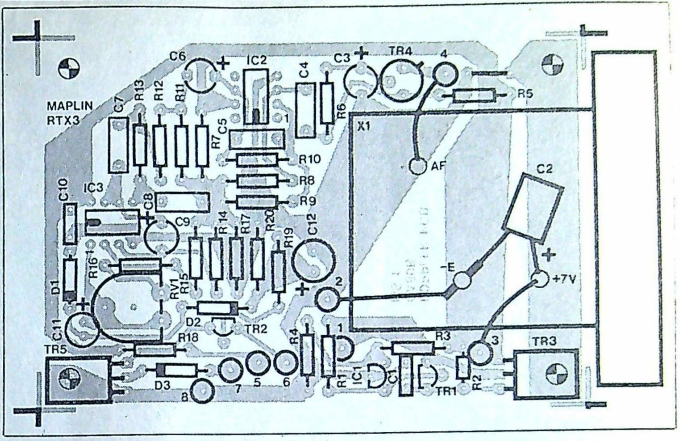


Figure 2. Component overlay of Doppler unit.

THE DOPPLER EFFECT

In 1842 an Austrian physicist, Christian Doppler discovered that the velocity of a sound source can change the frequency of that sound as perceived by an outside observer. For example if a car sounding its horn rapidly approaches an observer, the observer will note that as the car passes him the frequency of the horn drops. Although this is sound radiation, the same effect occurs with electro-magnetic radiation.

The reason for this is that for sound or electro-magnetic radiation, the speed of propagation (in the same medium) does not change. For electro-magnetic radiation this speed is about 300 million metres per second and generally denoted as 'c'. This speed remains the same regardless of the velocity of the source of the radiation relative to the observer.

Thus if a stationary source radiates for one second, the wave train produced will be 300 million metres long. Now imagine that the source moves away from the observer during the second when the radiation is emitted. The leading edge of the wave train will be 300 million metres from where the source was when the radiation started, but the end of the wave train will be where the source is at the end of the second.

So the length of the wave train is now 300 million metres plus the distance travelled by the source in that second. Since the transmitted frequency did not change, there must still be the same number of waves in this longer wave train as in the first one. If the observer now "listens" to this radiation for precisely one second, he will of course receive 300 million metres worth of both wave trains. The first wave train will contain all the waves transmitted, but the second wave train will not contain all the waves transmitted (because as we've seen there is actually more than 300 million metres worth of them). If there are fewer waves in the same distance then the distance between each wave must be greater. In other words the wavelength is longer and if the wavelength is longer then the frequency is lower.

In fact the observer would never know (unless he had other information) that it was not a stationary source that transmitted both signals. In the second case he would think that the source actually transmitted a lower frequency signal for a slightly longer time.

If the source had moved towards the observer during the transmission period, then the wave train would be shorter, the wavelength shorter and the frequency higher.

Construction

Insert the links and the 8 pins on the pcb, then taking care with the orientation of the diodes, IC's, transistors and C2, 3, 6, 9, 11 and 12 place the rest of the components except TR3 and TR5 and solder them all in position. Carefully align TR3 and TR5 above the holes in the pcb and then solder them in position, noting that no insulating washer is required. Drill the box and make the cut-out as shown in Figure 3, then place a 6BA ½in bolt in each of the four corner holes in the base and tighten a nut and washer on each bolt. Then sit the pcb on the nuts and fix with another nut and washer as shown in Figure 4.

Fix the antenna to the front plate of the box using two 6BA bolts. Now fix the CL8960 to this and tighten up. The CL8960 is supplied with two back-to-back diodes and a capacitor connected across the mixer diode for protection. These components must NOT be removed. Mount C2 from the +7V pin to the 0V pin as shown in Figure 2. Fix the LED either directly to pins 5 and 6 or to the hole marked 'A' in Figure 3. Connect the two wires between the pcb and the CL8960 as shown in Figure 2.

The 12V supply wires can now be connected; the positive to pin 1 and the negative to the CL8960 as shown in Figure 4. Make absolutely certain that you have connected the supply the right way round. Temporarily disconnect the wire from pin 3 on the pcb and connect a voltmeter between that pin and the chassis (0V). Connect the power supply. The voltmeter should read within ±1% of 7V, but many lower cost multimeters have far less accuracy than TL430C and in fact if your multimeter reads within ½V of 7V then it is very unlikely that there is a fault in the circuit. If all is well, remove the power supply, reconnect the wire to pin 3 and switch on again. The unit is now functioning.

The completed module is ideally situated in the corner of a room, but could be placed almost anywhere and may be disguised by covering the front. Any such covering should be thin paper, card or polystyrene and must be positioned not less than 2.5cm (1in) from the front of the box.

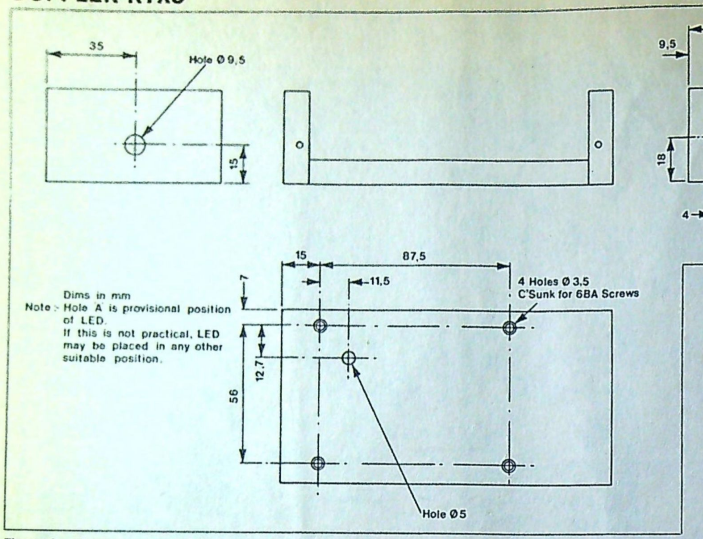


Figure 3. Box cut-out and drilling.

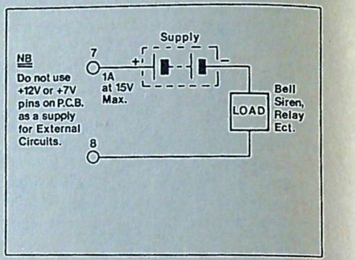

Supply
NB
Do not use +12V or +7V pins on P.C.B. as a supply for External Circuits.
7
+
-
1A at 15V Max.
LOAD
Bell Siren, Relay Ect.
8

Figure 5. Wiring of external alarm if not used with control unit.

Licensing Requirements

The Maplin RTX3 radar intruder detector has been approved by the Home Office if built from our kit of parts. The licence will only be issued if the following requirements are met:

i. The unit must be built from our kit and our construction details must be followed implicitly.
ii. The equipment must be clearly and permanently marked "MAPLIN RTX3" and the kit includes the adhesive label required.
iii. The equipment must only be used indoors.
iv. The equipment must not be used for any purpose other than intruder detection within buildings.
v. Any technical changes made to the design will render the equipment unacceptable for licensing.

Provided that the above conditions are met, the Home Office will issue a licence and the cost is only £3 for five years (at time of writing). You should note that it is illegal to operate the unit before you have a licence and to this end an application form is supplied with the kit. Otherwise application forms are available from:

Home Office,
Radio Regulatory Dept.,
R2 Division — Licensing Branch,
Waterloo Bridge House,
London SE1 8UA.
(Telephone 01-275 3058).

The application form must state that the equipment to be licensed is the MAPLIN RTX3 intruder detector otherwise a licence will not be issued.

We should like to thank those concerned at the Home Office for their assistance and for the prompt way in which our application for type-approval was dealt with. *Continued on page 62*

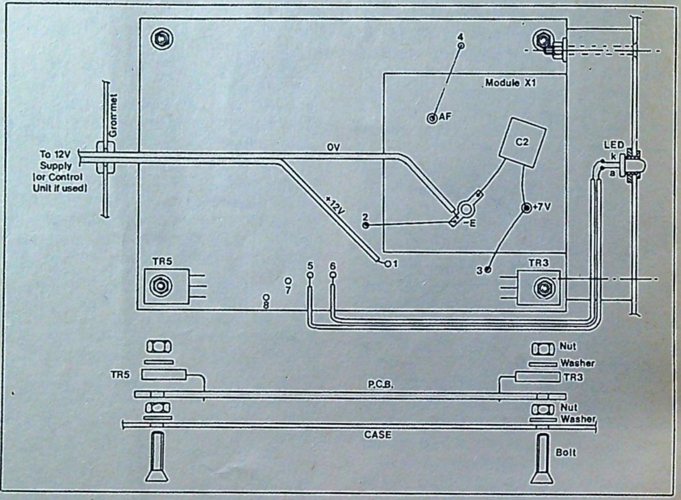
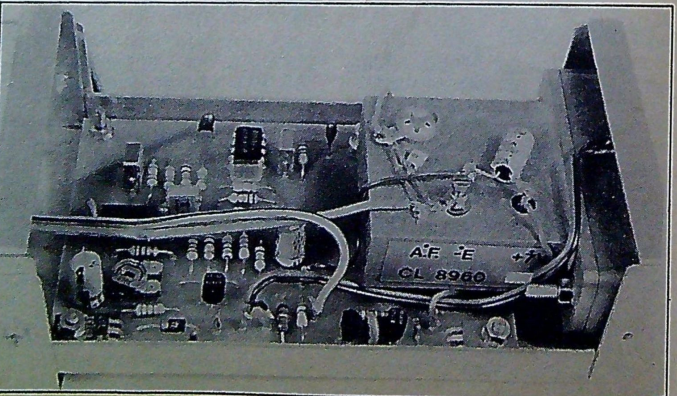


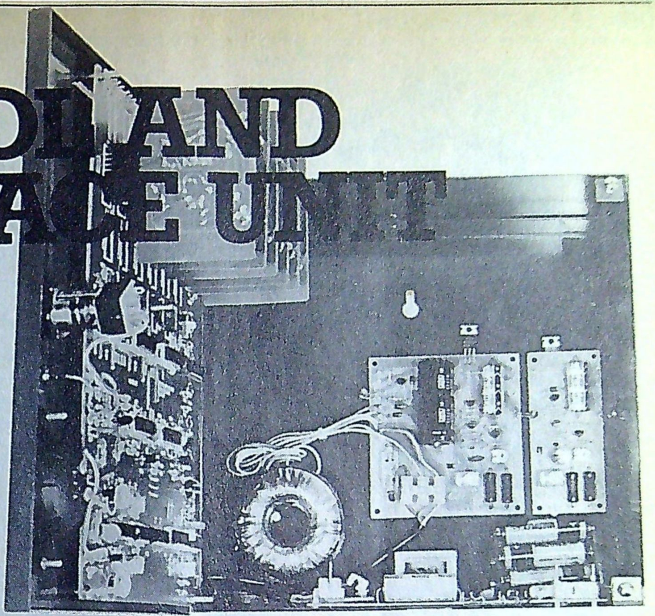
Figure 4. Assembly.



DOPPLER MODULE

CONTROL AND INTERFACE UNIT

by Dave Goodman



This unit provides a power supply for up to four radar modules and an interface for one radar module. Additional "extra channel" pcb's can simply be wired on to the side of the main pcb. Thus each interface module could be wired to individual channels on the Home Security System (described in issue 2) so that after triggering, the actual unit that fired would be indicated. Alternatively if that facility is not required then simply connect the relays in series as shown in Figure 1a and connect them to just one channel on the Home Security System.

The module provides the facility to connect a standby battery pack. Twelve nickel cadmium batteries are required and they are trickle-charged all the time mains is present. When mains fails, the batteries take-over without triggering the alarm. The size of battery used will depend on how many radar units are being used and how long you wish standby to last after mains fails.

The current drain from the battery for each radar module is 170mA. Thus with 12 fully charged 'C' cells (1800mAh types), four modules would run for about three hours and a single module for about 12 hours. Alternatively, a single module would run from 12 'AA' cells (500mAh) for about 3 hours.

If standby batteries are not used then although when mains fails the radar units cease to function and the alarm is not triggered, when mains returns, the radar units, in taking a few seconds to settle, will trigger the alarm. So it is a considerable advantage to have standby batteries and avoid this kind of false triggering.

This unit could be used with any alarm system, but note that the relay contact does not latch. The maximum contact rating is 1A at 24V DC.

Circuit Description

The unit runs directly from 240V AC mains via a 15V 30VA toroidal transformer. The secondary voltage is half-wave rectified and smoothed by C1 producing about 24V off-load. TR1 forms a constant current charger for the standby battery with the current set to 6mA by R2. Diode D3 is reverse

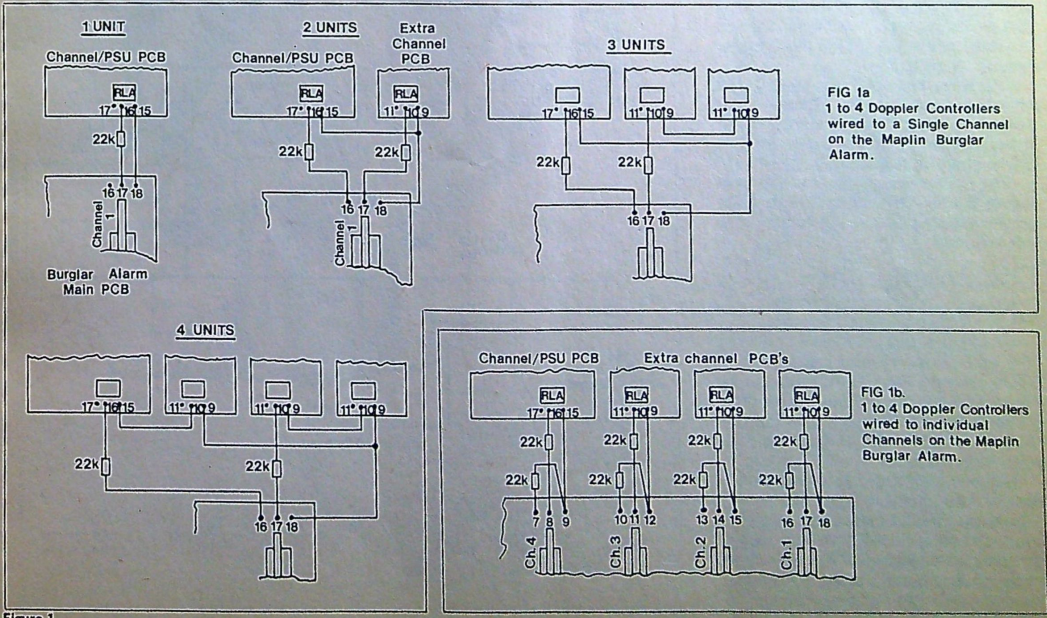


FIG 1a
1 to 4 Doppler Controllers wired to a Single Channel on the Maplin Burglar Alarm.

FIG 1b.
1 to 4 Doppler Controllers wired to individual Channels on the Maplin Burglar Alarm.

Figure 1.

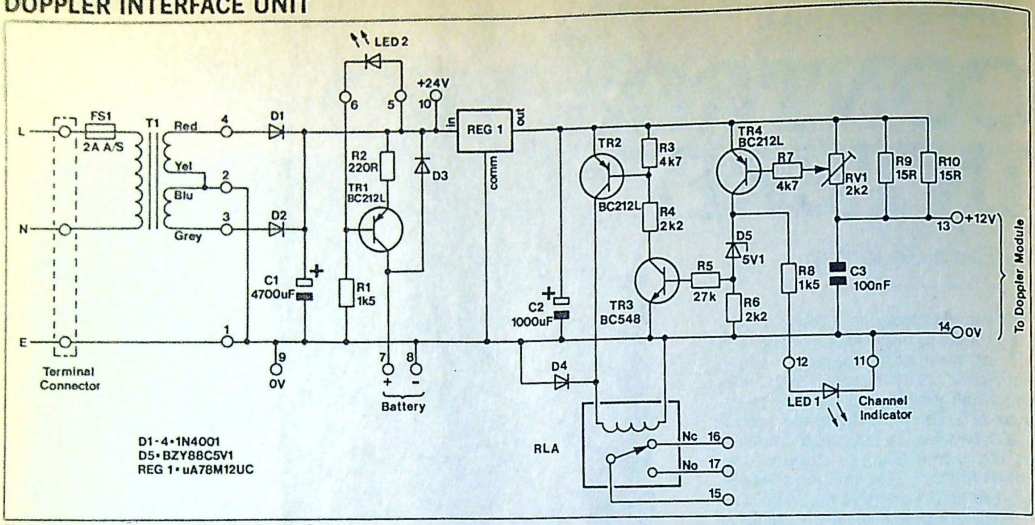


Figure 2. Circuit diagram of Channel/PSU PCB.

biased when mains and batteries are present, but when mains fails it becomes forward biased and the +24V rail drops to +15V. This is just sufficient to maintain the output of Reg 1 at 12V.

With a Doppler module connected to pins 13 and 14, the current through R9 and R10 in parallel provides a biasing voltage across RV1. With RV1 correctly adjusted, TR4 will be just turned on enough to light LED1, but not enough to operate TR3. TR2 will therefore not conduct and the relay will remain unoperated. If the Doppler module is triggered, the LED in the Doppler module lights and causes a tiny current change through R9 and R10. This change turns TR4 fully on and TR3 will turn on. This operates TR2 and the relay switches. The relay will only remain operated whilst the LED in the Doppler module is on.

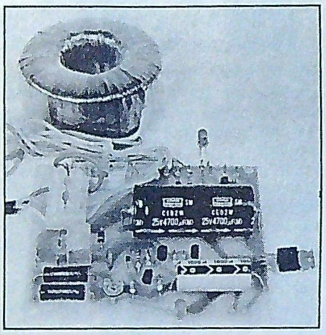
The advantage of this system is that only two wires are required and the wires themselves are constantly monitored. The alarm will fire if the wires are cut or short-circuited.

The extra channel pcb's as shown in Figure 3 are identical except that the power supply prior to the regulator is not included.

Construction of Channel/PSU PCB

Fit all the resistors, R1 to R10 and fit RV1 and solder. Fit and solder diodes D1 to D4 and Zener diode D5 taking care with orientation. Fit and solder the 17 Veropins and the disc capacitor C3, then C1, C2 and TR1 to 4 taking care with the orientation.

Relay RLA will only fit one way round, but be careful not to force the terminals, they should be carefully straightened and should then fit easily. Reg 1 can now be fitted below the pcb, then soldered and bent up so that it lies parallel with the pcb as shown in Figure 5.



Bolt the 3-way connector block to the pcb using two 6BA ½in bolts and nuts, then bolt the fuseholder to the pcb using a 6BA ¼in bolt and nut. LED1 and LED2 can now be connected as shown in Figure 4. These can be mounted directly to the pcb or externally depending on your requirements. LED2 shows that power is on and must be included if standby batteries are used. LED1 is used during testing, but can be omitted in use. If fitted, it lights when a Doppler module is connected.

Wire up the six colour-coded leads from the transformer as shown in Figure 4. Cut 8cm (3in) off the piece of mains cable (note that this is not

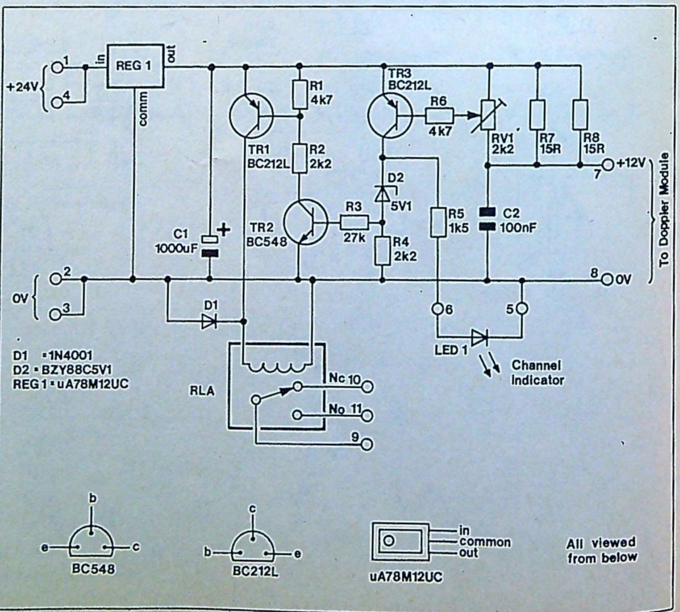
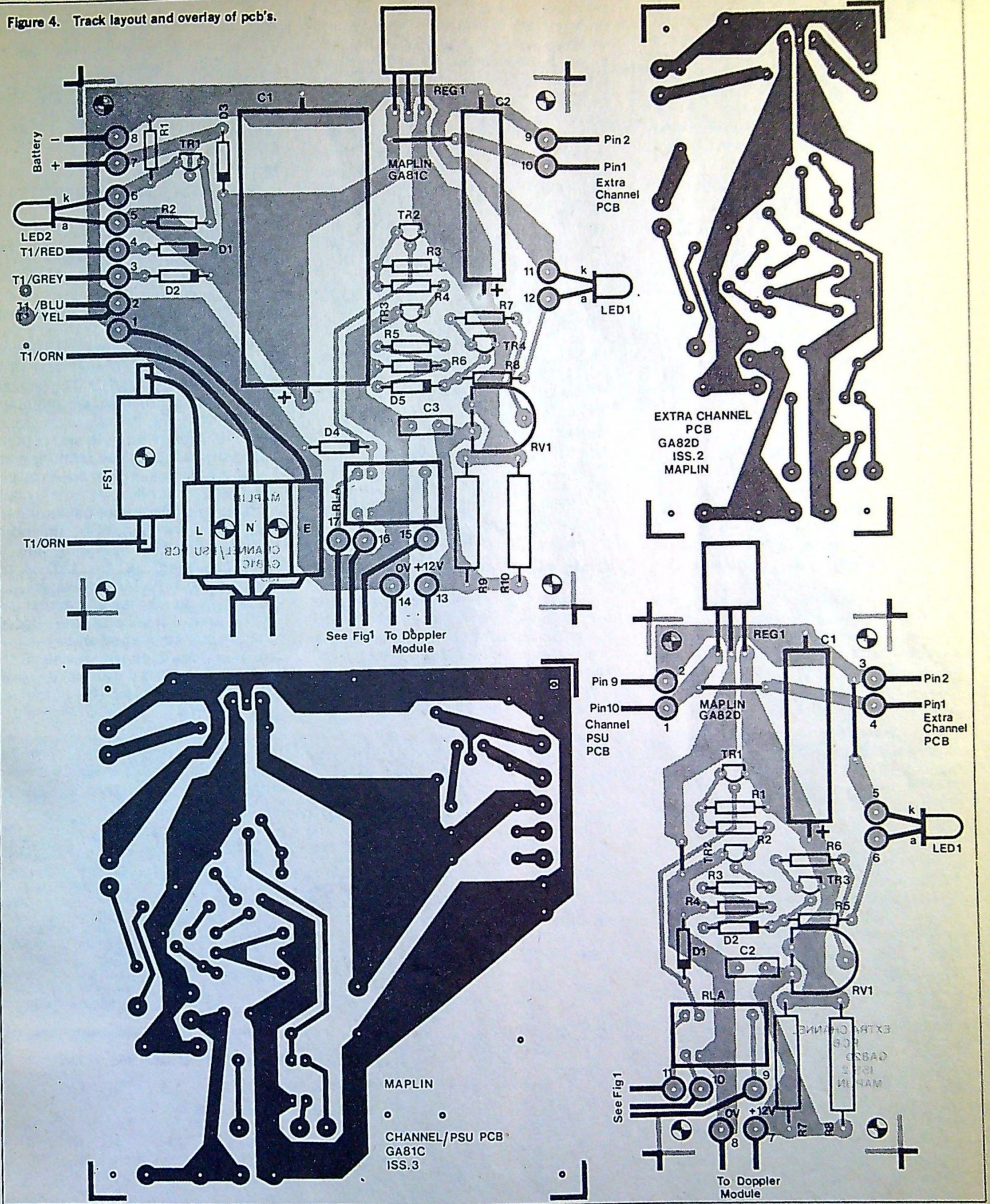
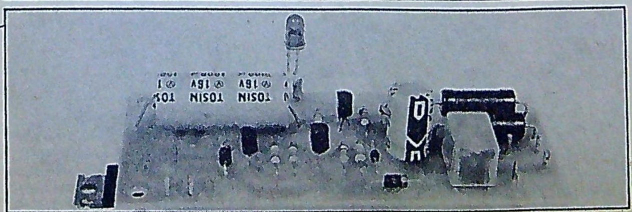


Figure 3. Circuit diagram of Extra Channel PCB.

Figure 4. Track layout and overlay of pcb's.





Completed extra channel pcb.

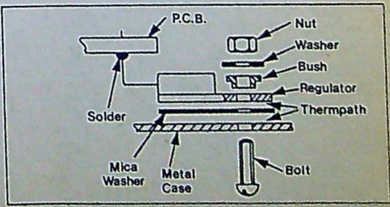


Figure 5. Mounting regulator 1.

supplied in the kit) and use the piece of brown wire to connect from the terminal block live to FS1. Use the piece of green/yellow to connect from the terminal block earth to pin 1. These connections are shown in Figure 4. The mains cable itself can now be connected to the other side of the terminal block and this is also shown in Figure 4.

Construction of Extra Channel PCB's

Extra channel pcb's can now be constructed in the same way as the channel/psu pcb's, though of course there are less components. The LED on this board is exactly the same as LED1 on the channel/psu pcb and again although required during testing, it can thereafter be omitted if not required.

Assembly

Mount the transformer with the mounting kit supplied with the transformer and then fix the pcb's side-by-side (if extra channel pcb's are in use) so that pin 9 on the channel/psu pcb is adjacent to pin 2 on the extra channel pcb and, if further extra channel pcb's are in use, so that pin 3 on the left-hand one is adjacent to pin 2 on the right-hand one.

Fix the boards using four ½in spacers and four 6BA ½in nuts, bolts and washers. With reference to Figure 5, bolt the regulator to the metal box using the mounting kit smeared with silicone grease e.g. Thermpath (not supplied in kit) and a 6BA ¼in bolt, nut and washer. The size of metal box in which the unit is mounted will depend on how many channels you require and whether you are having standby batteries, but whatever the size this will be a sufficient heatsink for the regulator.

When choosing a box, remember to leave room for the standby batteries. These can be fitted using our battery holders e.g. for 'C' cells use three HF95D or HF96E and for 'AA' cells use two HQ01B or YR62S. There may be sufficient room for everything in the main box of the Home Security System in which case the back of the box will form the heatsink for Reg 1.

If more than one channel is in use, then wire the pcb's together with strapping wire by linking the pins as follows:

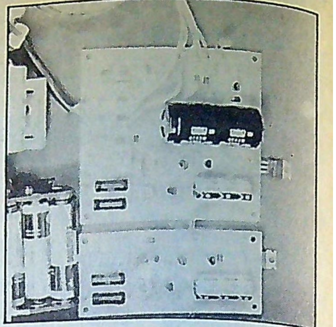
Channel/PSU PCB		Extra Channel PCB
pin 9	to	pin 2
pin 10	to	pin 1

The extra channel pcb can then be extended on again as follows:

1st or 2nd Extra Channel PCB		2nd or 3rd Extra Channel PCB
pin 3	to	pin 2
pin 4	to	pin 1

Setting-up

Switch the mains on and measure the voltage between pin 13 and 14 on the channel/psu pcb and between pin 7 and pin 8 on the extra channel pcb. The meter should read approximately 12V. Note that pins 14 (and 8) are 0V and the +12V should be on pins 13 (and 7). The pin numbers in brackets are for the extra channel pcb.



If all is well, connect a Doppler module to pins 13(7): +12V and 14(8): 0V. Adjust RV1 so that LED1 lights and check that if the Doppler module is removed the LED extinguishes. Reconnect the Doppler module and continue adjusting RV1 until the relay operates i.e. the LED and relay are now both operated.

Now turn the preset back until it is roughly in the middle of the region between the LED operating and the relay operating, i.e. the LED is now operated and the relay released. Connect a 2k to 3k resistor across pins 13(7) and 14(8) with the Doppler module still connected and check that the relay operates. Otherwise further adjustment of RV1 will be necessary. Remove the resistor. The output can now be wired as shown in Figure 1. ■

CHANNEL/PSU PARTS LIST

Resistors — all ¼W 5% carbon unless specified			
R1,8	1k5	2 off	(M1K5)
R2	220R		(M220R)
R3,7	4k7	2 off	(M4K7)
R4,6	2k2	2 off	(M2K2)
R5	27k		(M27K)
R9,10	15R (7W wirewound)	2 off	(L15R)
RV1	2k2 horizontal sub-min preset		(WR56L)
Capacitors			
C1	4700uF 25V axial electrolytic		(FB96E)
C2	1000uF 16V axial electrolytic		(FB82D)
C3	100nF disc ceramic		(BX03D)
Semiconductors			
D1,2,3,4	1N4001	4 off	(QL73Q)
D5	BZY88C5V1		(QH07H)
LED1,2	LED red	2 off	(WL27E)
TR1,2,4	BC212L	3 off	(QB60Q)
TR3	BC548		(QB73Q)
REG 1	uA78M12UC		(QL29G)
Miscellaneous			
T1	Toroidal 15V 30VA		(YK11M)
RLA	Ultra min relay SPDT		(YX94C)
FS1	20mm A/S fuse 2A		(WR20W)
	Chassis fuseholder 20mm		(RX49D)
	Mounting kit (P) plas		(WR23A)
	Channel/PSU pcb		(GA81C)
	Terminal block (3-way)	part of	(HF01B)
	Veropin 2141	17 off	(FL21X)
	Bolt 6BA ¼in	2 off	(BF05F)
	Bolt 6BA ½in	6 off	(BF06G)
	Spacer 6BA ¼in	4 off	(FW34M)
	Washer 6BA	5 off	(BF22Y)
	Nut 6BA	8 off	(BF18U)
	Strapping wire 24swg	1m	(BL15R)
	*Mains cable	as required	(XR01B)
	*Thermpath	as required	(HQ00A)

A complete kit of parts containing all the above items except those marked * is available.
Order As LW74R (Radar Channel/PSU Module) Price £13.95

EXTRA CHANNEL PARTS LIST

Resistors — all ¼W 5% carbon unless specified			
R1,6	4k7	2 off	(M4K7)
R2,4	2k2	2 off	(M2K2)
R3	27k		(M27K)
R5	1k5		(M1K5)
R7,8	15R (7W wirewound)	2 off	(L15R)
RV1	2k2 horizontal sub-min preset		(WR56L)
Capacitors			
C1	1000uF 16V axial electrolytic		(FB82D)
C2	100nF disc ceramic		(BX03D)
Semiconductors			
D1	1N4001		(QL73Q)
D2	BZY88C5V1		(QH07H)
LED1	LED red		(WL27E)
TR1,3	BC212L	2 off	(QB60Q)
TR2	BC548		(QB73Q)
REG 1	uA78M12UC		(QL29G)
Miscellaneous			
RLA	Ultra min relay SPDT		(YX94C)
	Mounting kit (P) plas		(WR23A)
	Extra channel pcb		(GA82D)
	Veropin 2141	9 off	(FL21X)
	Bolt 6BA ¼in		(BF05F)
	Bolt 6BA ½in	4 off	(BF06G)
	Spacer 6BA ¼in	4 off	(FW34M)
	Washer 6BA	5 off	(BF22Y)
	Nut 6BA	5 off	(BF18U)
	*Thermpath	as required	(HQ00A)

A complete kit of parts containing all the above parts except that marked * is available.
Order As LW75S (Radar Extra Channel Module) Price £4.50

THE VIC 20 COLOUR COMPUTER

by Chris Barlow

Commodore, the manufacturers of the VIC20 are already a well known name in the micro-computer world. Their PET micro-computer has sold more than 50,000 units in the UK, mostly to schools and businesses. Its popularity in schools is probably due to Commodore's excellent programming language PET BASIC which is one of the easiest computer languages to learn. This same BASIC is supplied with the VIC20. In fact all the best features of the PET have been included in the VIC, but because a monitor is not included, the price is much lower.

The VIC20 is a full-fledged computer and is truly expandable into a very sophisticated computer system. Although it doesn't have its own monitor like the PET, it can be used with any ordinary domestic television (625-line PAL) and simply plugs straight into the aerial socket like a video recorder or home games machine. With every computer there is a friendly guide called "Personal Computing On The VIC20" that explains to every owner, including the first-time user, exactly how to get good results from the VIC20.

The best way to get to know the VIC20 is to take a quick tour of the keyboard. The keyboard contains upper and lower case keys, numbers and symbols, just like a typewriter keyboard. In addition, there are special editing keys, and the famous "PET GRAPHICS" character set. Here then, is a brief "tour" of the VIC keyboard:

Graphics & the Commodore Key

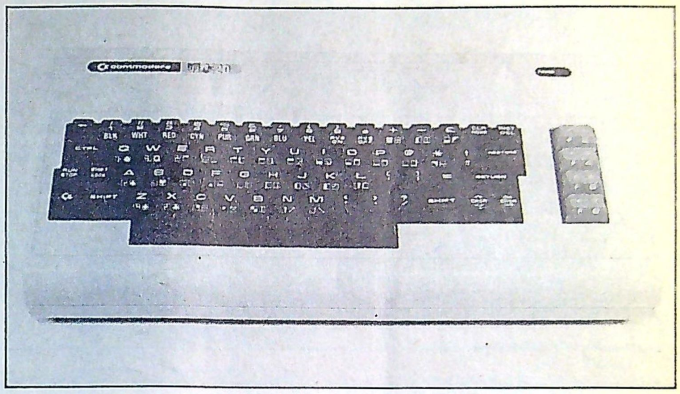
When you turn on the VIC, you're automatically in "graphics" mode which means you can type upper case letters AND the more than 60 graphics you see on the keys. There are two graphics on each key. To get the graphic on the right side, simply hold down the SHIFT key and type the key with the graphic you want. To get the graphics on the left side, hold down the "COMMODORE" key (the little flag). In this way, you can type upper case letters and the full graphics set at the same time!

Upper/Lower Case & Graphics

To get into the "text" mode you simply press the SHIFT and COMMODORE keys together. This lets you use the VIC like an ordinary typewriter, with full upper and lower case letters, plus all the graphics on the LEFT side of the keys. These are the graphics which are most suited for charts, graphs and business forms.

Colour

You can change the colours of the characters you type by pressing the CTRL key and one of the 8 colour/number keys. The colours are black, white, red, cyan, purple, green, blue and yellow. You can set — and change — colours inside or outside a computer program. In addition to the eight character colours, you can also change the colours of the border and screen on your television set, by typing a special command called a "Poke". For example, if you type the command Poke 36879, X where X is some number from 1 to 255, you can get up to 255 different combinations of screen and border colours, including 16 screen colours and 8 border colours.



Special Editing Keys

Here are some of the other special keys which make the VIC such a powerful microcomputer:

CTRL — used to set character colours, and, in conjunction with special programs such as wordprocessing, to execute special commands.

Software writers can select their own "Control" commands and incorporate them into their programs.

Run/Stop — The run/stop key lets you automatically load programs into the VIC's memory from a cassette tape. Hitting this key without shifting (i.e. Stop) interrupts a running program or listing. If you stop a program and want to resume it where you left off, you can type "cont" and the program will "continue".

Shift — The VIC has two shift keys and a shift lock key, just like a typewriter, for typing long strings of upper case letters or graphics.

RVS on and RVS off — These two keys let you type reverse characters on the screen (for instance white on black instead of black on white).

Joystick Demonstration Program

```
10 PRINT "♥" : X = 7680 : Z = 0 : V = 1 : POKE
   37154, 127
20 FOR C = 38400 TO 38960 : POKE C, 6 :
   NEXT C
30 A = PEEK (37151) : POKE X, 224
40 IF A = 122 THEN X = X-22 : V = V-1 :
   IF V   1 THEN X = X+22 : V+1
50 IF A = 118 THEN X = X+22 : V = V+£ :
   IF V   23 THEN X = X-22 : V = V-1
60 IF A = 110 THEN X = X-1 : Z = Z-1 :
   IF Z   0 THEN X = X+1 : Z = Z+1
70 IF PEEK (37152) = 119 THEN X = X+1 :
   Z = Z+1 :
   IF Z   21 THEN X = X-1 : Z = Z-1
80 GOTO 30
```

CLR/Home — This key makes the cursor move to the "home" position at the top left hand corner of the screen. If you type shift and CLR/home you "clear" the screen of all the characters that were present.

Inst/Del — This is a super editing key which lets you insert or (shifted) delete characters. It's great for correcting mistakes and inserting extra information.

Restore — This is a "reset" key. If you type the run/stop key and the restore key together, you complete reset the computer as if you had just turned it on . . . with the benefit that any programs you had in the memory are retained and can be listed or run from the start.

Cursor Keys — Ability to move the screen cursor up and down and sideways by hitting single keys is a powerful feature of the VIC. Being able to move the cursor this easily is essential but not all computers include it as a feature.

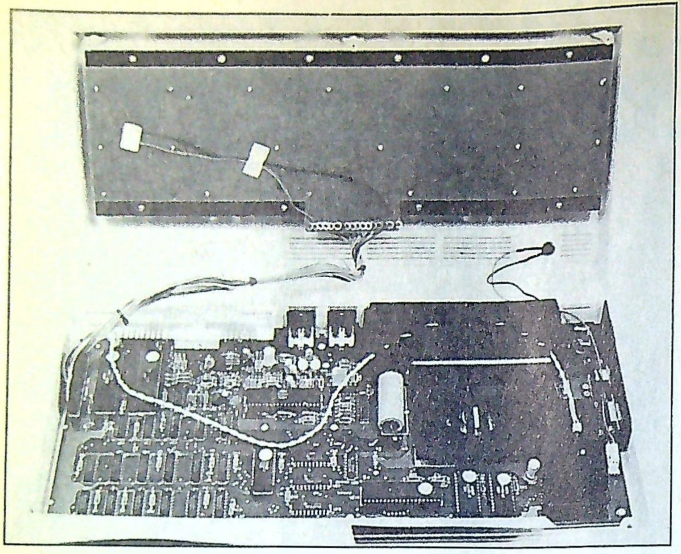
Return — The return key is used primarily for entering commands and instructions to the computer.

Programmable Function Keys

One of the most unique features on the VIC is that mysterious vertical row of "function" keys on the far right side of the keyboard. There are four keys and (if you shift them) a total of eight functions. These keys are not defined when you turn on the computer, but you may assign any BASIC command or instruction set to them, under program control.

Inside the VIC20

Inside the VIC20 there are some very powerful integrated circuits. The microprocessor chip itself is the 6502. The memory is divided into two parts. The first part is the ROM (read only memory) that stores the BASIC, the alpha-numeric characters and the graphics characters, input and output routines and the operating system 'Kernal'. The total amount of ROM supplied is 20K, but this can be increased to 32K, and addresses 40960 to 49151 are reserved for plug-in ROM such as VIC's game cartridges.



Colour Demonstration Program

```
10 PRINT "⊐" POKE 36879, 8
20 FOR D = 7680 TO 8185 : POKE D, 224 :
   NEXT D
30 C = INT (RND(1)x506) + 38400
40 A = INT (RND(1)x8) : IF A   1 THEN 40
50 POKE C, A : GOTO 30
```

The second part of the memory is RAM. The VIC20 contains 5K of static RAM (2114) and 3.58K of this is free space for your programs. More RAM can be added up to a total of 32K and addresses 8192 to 32767 are reserved for further expansion of RAM. The first part of RAM is allocated to BASIC working storage and tape buffer, screen storage etc.

The second important chip in the VIC is the one from which the name of the computer is derived. This chip, a 6561, is a video interface chip (VIC). It is a powerful colour graphics and sound generator and incorporates two 8-bit analogue to digital converters for two paddles for playing arcade-type games. The VIC also generates the video sync., luminance and colour information needed by a standard UK television to provide a full colour picture.

To produce programmable colour characters, VIC accesses three areas of memory — display characters, character pointers and colour pointers. Each character is stored in a cell of 8 x 8 bits and it is this data that makes up each of the characters stored in ROM. However, it is possible under software control to write your own character set in RAM, remembering of course that a complete set will take up 4K in the memory.

Most computer games use re-defined characters to create the special symbols and objects such as those used in Commodore's Alien Invaders or Tank Command or Air Sea Battle, etc. Re-defined characters could also be used though to make musical notes or the characters for foreign languages or scientific symbols etc.

The video screen is stored in RAM locations 7680 for the top left-hand corner of the screen to 8186 for the bottom right-hand corner. The position of this RAM will move if more RAM is added to the VIC20. If there is more than 8K of RAM then the addresses change to 4096 to 4602.

Similarly the colour addresses for the screen display start at address 38400 for the top left-hand corner and go to 38906 for the bottom right-hand corner. The values stored in these addresses set the colour of the character displayed on the screen in each position. Again the addresses move if there is more than 8K of RAM fitted. The new addresses are 37888 to 38394. In the Colour Demonstration program shown in the panel, remember to change the addresses if you have more than 8K of RAM.

The VIC chip has many more functions, but we have quickly covered here some of the more useful ones.

The VIC20 Joystick

The VIC20 has provision for a joystick and this can be used in games or simulation programs. Inside the joystick are five switches. Four switches are for joystick movement and one is the 'fire' button. When the joystick is in a diagonal position, two of the four movement switches will be closed and this sets a particular value in the VIC20. These joystick position values are stored in addresses 37151 and 37152 as shown in the diagram.

The value in address 37151 changes when the joystick is moved to close the switches for up, down and left and it also changes when the fire button is pressed. If the joystick is central and therefore no switch is closed then the value in 37151 is set to 126. This changes to 94 if the fire button is pressed. if the joystick is moved to close the 'up' switch, the value changes to 122 or to 90 if the fire button is pressed and so on as shown in the diagram.

The fourth stick switch changes the value in location 37152, but this address is also used for keyboard scanning. To make this location 'see' the joystick, you have to POKE 127 at address 37154, not forgetting to return it to 255 when you want keyboard scanning to resume. Once 37154 is set to 127, location 37152 will contain the value 247 when the joystick right switch is open and 119 when the switch is closed. Clearly your program will need to contain a short algorithm to detect when the top right diagonal is called i.e. when top and right switches are closed, or when the bottom right diagonal is called. A short joystick demonstration program is shown in the panel.

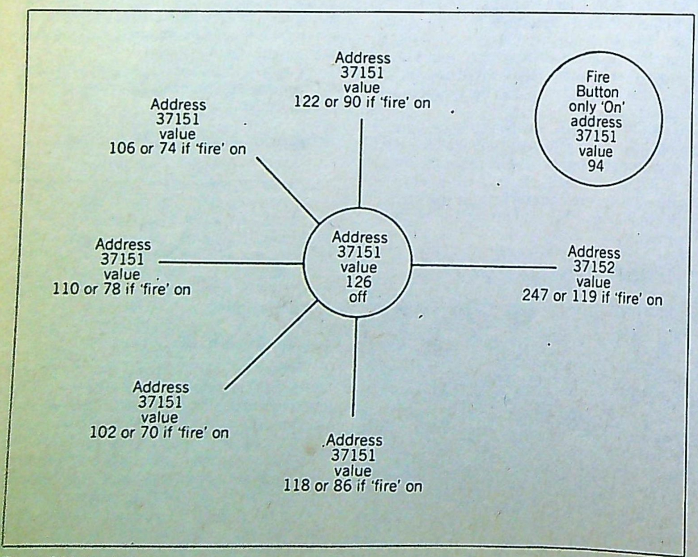
The Actual Equipment

Here's a brief technical description of the computer itself and all the add-ons available at the moment.

The VIC20 Colour Computer Specification

5K RAM expandable up to 29K (a further 3K could be added, but this would not be addressable from BASIC).

RS232C interface capability.



The VIC 20 Joystick.

8 border colours, 16 screen colours which can be mixed.

8 screen character colours generated directly from the keyboard.

3 audible tone generators, each of 3 octaves.

A white noise generator for sound effects.

22 characters wide by 23 lines deep screen display.

88 character program line length.

64 ASCII character set, upper and lower case alphabetics plus numerics.

Full PET-type graphics character set generated directly from the keyboard.

High resolution graphics capability either directly from defined keyboard characters or via a high resolution graphics cartridge.

176 x 158 pixels (27,808 in total) maximum resolution.

8 programmable special functions accessed via 4 special function keyboard keys.

Automatic repeat on space bar, insert, delete and cursor control keys (other keys can be programmed to repeat).

The console comes complete with a power pack and modulator and the necessary connecting leads and a users' handbook.

Order As AF47B (VIC20 Colour Computer).
Price £199.99

VIC C2N Cassette Unit

This cassette unit plugs directly into the computer console and may be used to store your programs. It can also be used to run pre-recorded programs on cassette such as Commodore's 'Teach Yourself Programming.'

Order As AF48C (VIC20 Cassette C2N)
Price £44.95

VIC Printer

A tractor-feed 80 character-per-line, 30 characters-per-second printer that plugs directly into the VIC20 console or into the disk drive if that is in use.

Order As AF49D (VIC20 Printer)
Price £230.00

VIC Disk Drive

A disk drive that plugs directly into the VIC20 console. The drive may be used with standard single-sided, single density 5¼ inch floppy disks and about 170K bytes of storage is available.

Order As AF50E (VIC20 Disk Drive)
Price £396.00

Add-on RAM Cartridges

Any one of these add-on cartridges will plug directly into the VIC20 console. However, if a plug-in ROM cartridge is used, the memory would have to be removed. If you wish to use more than one RAM cartridge or you want to keep the RAM connected when running games, then you will need the Memory Expansion Board described below. The add-on RAM is available in three sizes.

Order As AF51F (VIC 3K RAM) Price £29.95
AF52G (VIC 8K RAM) Price £44.95
AF53H (VIC 16K RAM) Price £74.95

VIC20 Memory Locations

0 to 1023 Working storage RAM (1K)
1024 to 4095 Expansion RAM (3K)
4096 to 7679 User RAM (3.5K)
7680 to 8191 Screen RAM (0.5K)
8192 to 16383 Expansion RAM/ROM (8K)
16384 to 24575 Expansion RAM/ROM (8K)
24576 to 32767 Expansion RAM/ROM (8K)
32768 to 36863 Character ROM (4K)
36864 to 37135 VIC address (0.27K)
37136 to 37887 I/O 1 (0.73K)
37888 to 38911 Colour RAM (1K)
38912 to 39935 I/O 2 (1K)
39936 to 40959 I/O 3 (1K)
40960 to 49151 Expansion ROM (8K)
49152 to 57343 BASIC ROM (8K)
57344 to 65535 Kernal ROM (8K)

Memory Expansion Board

This board plugs directly into the VIC20 console and has four input sockets. Up to four of the following items can be connected: 3K RAM, 8K RAM, 16K RAM, program cartridges, or any IEEE devices such as PET/CBM peripherals.

Order As AF54J (VIC Memory Expansion)
Price £125.95

Joysticks and Paddles

A pair of paddles or one joystick may be connected directly to the VIC20 console. (An expander will be available soon to allow two joysticks to be connected, however all the programs available at the moment that use joysticks, require only one). Most of the game cartridges require joysticks, except Super Slot where paddles are required.

Order As AC53H (Single Game Joystick)
Price £7.50
AC37S (Pair of Joysticks)
Price £13.95
AC45Y (Le Stick) Price £24.95
AC30H (Pair of Paddles)
Price £13.95

Programming Aid Cartridges

Three plug-in cartridges for the programmer. Super Expander contains 3K of RAM and enables high resolution graphics up to 176 x 158 pixels to be obtained. Programmers Aid contains additional commands, function key programming and much more. The third cartridge is a machine code monitor.

Order As AC54J (Super Expander)
Price £34.95
AC55K (Programmers Aid)
Price £34.95
AC56L (Machine Code Monitor)
Price £34.95

Introduction to BASIC

Two program cassettes with documentation to help you learn BASIC on the VIC.

Order As AC57M (Intro to BASIC Part 1)
Price £14.95
AC58N (Intro To BASIC Part 2)
Price £14.95

Game Programs

The following game programs are available on cartridge except for Blitz which is on cassette.

Order As AC59P (VIC Avenger Game)
Price £19.95
AC60Q (VIC Star Battle Game)
Price £19.95
AC61R (VIC Super Slot Game)
Price £19.95
AC62S (VIC Jelly Monsters Game)
Price £19.95
AC63T (VIC Alien Game)
Price £19.95
AC64U (VIC Super Lander Game)
Price £19.95
AC65V (VIC Road Race Game)
Price £19.95
AC66W (VIC Rat Race Game)
Price £19.95
AC67X (VIC Blitz Game)
Price £4.99

Books About VIC

Three books are available to help you really get to know the VIC computer.

Order As WA31J (Learn Programming On The VIC) Price £2.50*NV*
WA32K (VIC Revealed)
Price £11.50*NV*
WA33L (VIC Programmers Reference Guide) Price £16.50*NV*

The Future

In our next issue we shall be giving more details about the VIC software. Lots more software will become available later this year. Game programs to be released include Sargon II, Chess, Pinball, Cosmic Jailbreak, Omega Race and Gorf. Adventure programs coming soon include Adventure Land, Treasure Island, Mission Impossible, Voodoo Castle and The Count. Business programs to be released are Simplicalc — a simplified version of Visicalc, Stock Control, File — a data-base handling program, and Letter Writer — a word processor. Also during this year 10 or 11 programs are being released on specific subjects to help with O-level and CSE revision. ■

NEW ITEMS USED IN PROJECTS IN THIS MAGAZINE

GA65V	Sequencer PSU PCB	**Price £1.35**
GA71N	Stereo Amp PCB	**Price £4.60**
GA78K	Stereo Amp Switchboard	**Price 55p**
GA81C	Channel/PSU PCB	**Price £1.85**
GA82D	Extra Channel PCB	**Price £1.35**
GA83E	ZX81 Keyboard PCB	**Price £2.95**
GA84F	Remote Data Latch PCB	**Price £2.10**
GA85G	Data Encoder PCB	**Price £2.49**
GA86T	Data Decoder PCB	**Price £2.45**
GA87U	Infra-red Transmitter PCB	**Price £1.25**
GA88V	Infra-red Receiver PCB	**Price £1.25**
GA89W	27MHz Transmitter PCB	**Price £1.50**
LW66W	Sequencer Kit	**Price £125.00**
LW71N	Stereo Amp Kit	**Price £49.95**
LW72P	ZX81 Keyboard Kit	**Price £19.95**
LW73Q	RTX3 Doppler Kit	**Price £39.95**
LW74R	Channel/PSU Kit	**Price £13.95**
LW75S	Extra Channel Kit	**Price £4.50**
QY17T	2716/M3	**Price £14.95**
RK25C	Stereo Amp Heatsink	**Price £1.25**
RK26D	Axial 4700uF 40V	**Price £1.40**
RK27E	Adaptor L	**Price 60p**
RK28F	RA Flexiconnector 5-way	**Price 20p**
RK29G	RA Flexiconnector 8-way	**Price 25p**
RK30H	Flexicable 7-way	**Price 54p**
RK31J	Flexicable 10-way	**Price 65p**
RK32K	Sequencer Key Print	**Price 65p**
XH58N	ZX81 Key Print	**Price 25p**
XG15R	Stereo Amp Chassis	**Price £5.95**
XG16S	Stereo Amp Woodwork	**Price £6.25**
XG17T	ZX81 Keyboard Case	**Price £4.95**
YQ56L	Sequencer PCB	**Price £4.75**
YQ57M	Sequencer Display PCB	**Price £1.65**
YQ58N	Sequencer Keyboard PCB	**Price £2.35**
YQ59P	Sequencer Interface PCB	**Price £2.10**

REMOTE CONTROL

for Digital Multi-Train Controller

by Robert Kirsch

- ★ **Infra-red, radio and wire remote control systems described**
- ★ **Any 4 locomotives controlled simultaneously from remote controller**

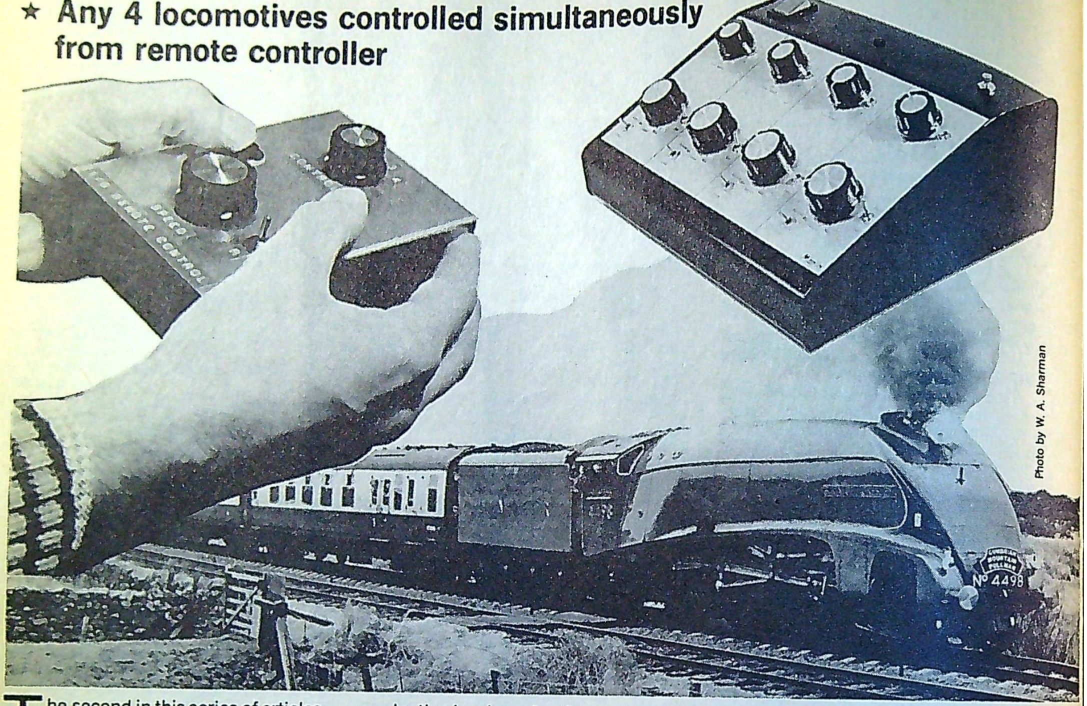


Photo by W. A. Sharman

The second in this series of articles on model railway projects describes the addition of remote control facilities to the train controller described in the previous issue. This addition enables any or all of the four control boards to be commanded by an 8-bit digital input either from the remote controller or a computer. The data for each controller is latched and thus one train can be set running and the command changed to another controller to enable up to four trains to be controlled simultaneously by the external input. Figure 1 shows the block schematic diagram of the remote control system.

Additions To Control Board Circuit

Figure 2 shows the complete circuit of the control board with the extra parts added. As described previously, the board works by allowing a group of TS pulses to be sent to the 6 common lines depending on the direction and train to be controlled. The length of this group of pulses determines the speed of the train; thus with no pulses the train is stationary and with a full ten pulses per group, the train is at maximum speed.

In the local mode, the number of pulses in the group is set by selecting one of the ten outputs from the 4017 decade counter (IC1) and using this to trip the output gate after the appropriate number of pulses have been sent. The same applies in the remote mode, except that in this case the output gate is tripped when the output from the binary counter (IC101) is the same as the 4-bit input from the external source. This is detected by the 4-bit magnitude comparator (IC102), The direction in travel in the remote mode is controlled by simply gating the TS pulses fed to the appropriate line

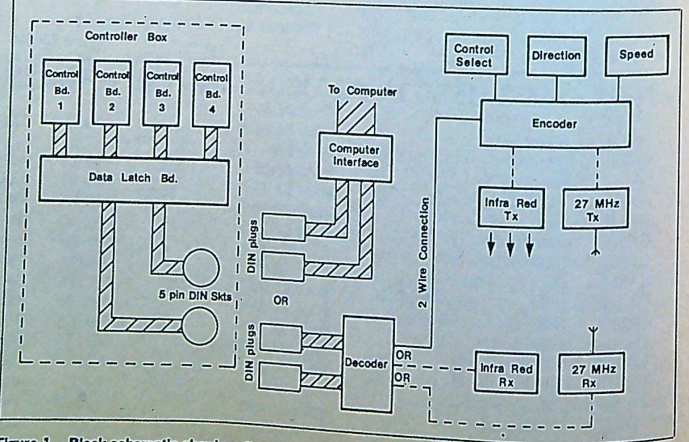


Figure 1. Block schematic showing all options.

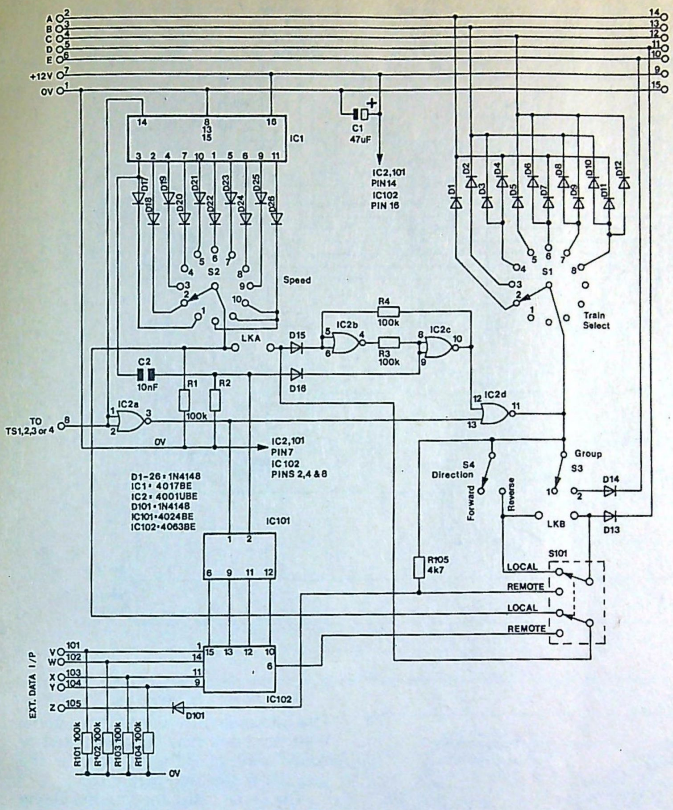


Figure 2a. Circuit diagram of complete Control board.

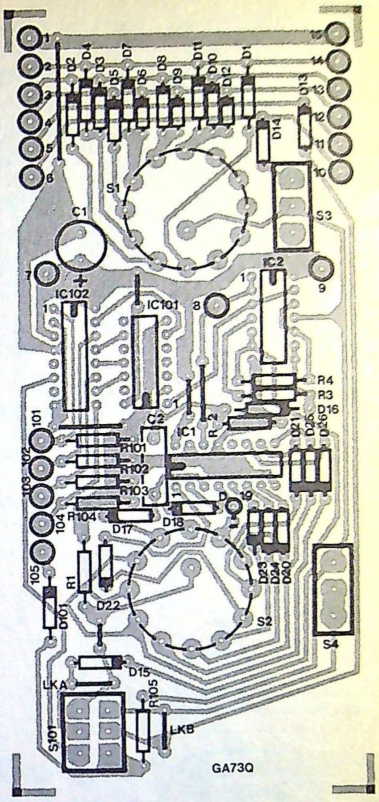
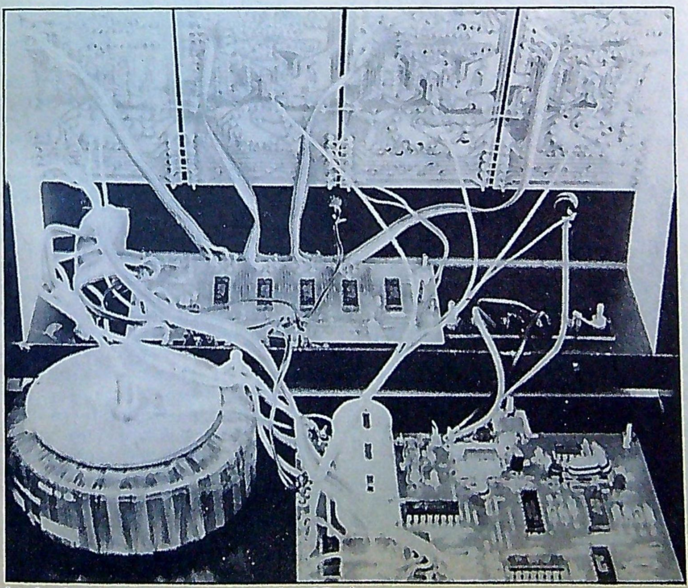


Figure 2b. Component layout of Control board.



Interior view of controller with Data Latch board fitted.

under control of the fifth bit of external data.

Remote Data Latch Board

The data for each of the four control boards is stored by one of the four latches (IC1 to 4); see Figure 3. The control board to be commanded is selected by the conditions applied to the input lines B5 and B6, and this is decoded by IC5 and the diodes D2 to D9 allowing the TS pulse to clock only the required latch.

The eighth bit of the control word may be used for any function required, but we have shown it connected to the power reset circuit. This requires an output only when the button on the remote controller is pressed, so no latch is needed.

Remote Control Data Encoder Board

This board enables any one of the four control boards to be selected and the speed and direction of the train selected by that board to be controlled.

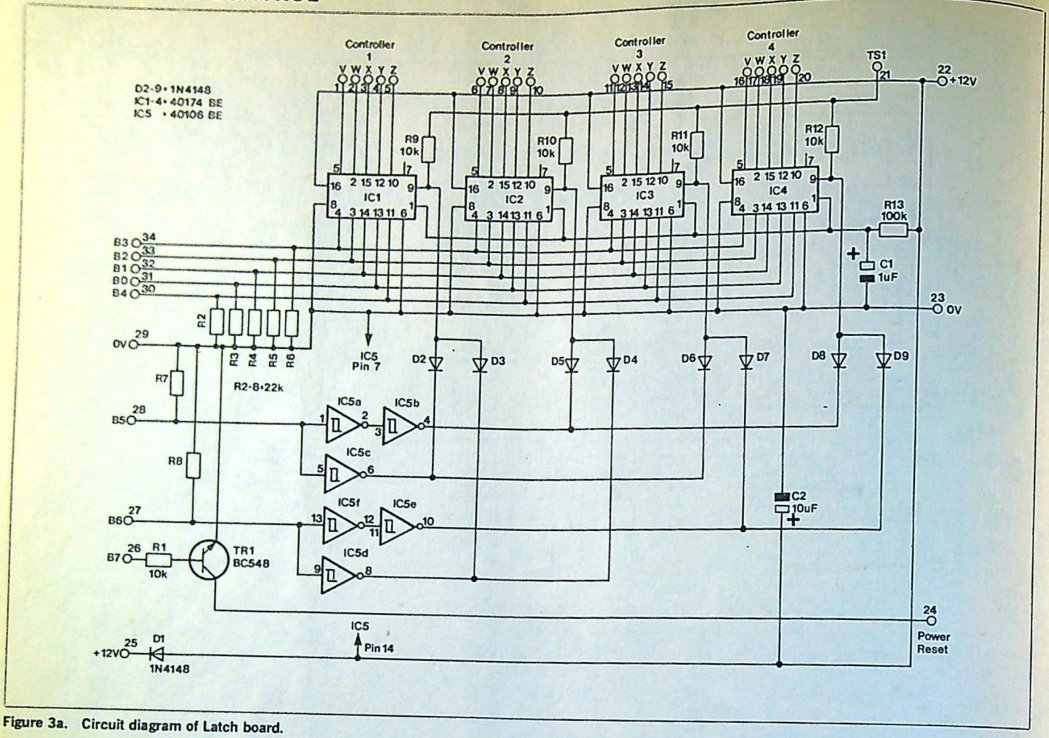


Figure 3a. Circuit diagram of Latch board.

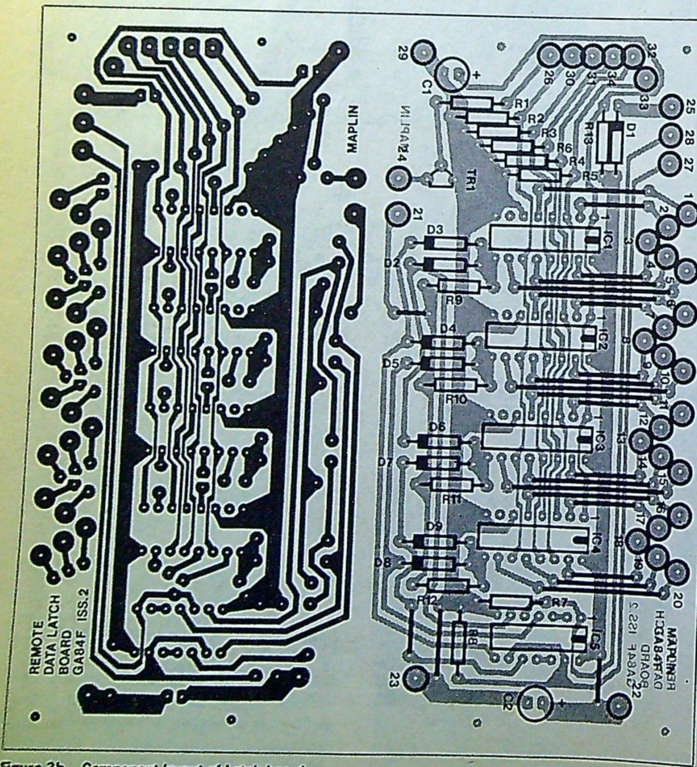


Figure 3b. Component layout of Latch board.

The information is turned into a serial 8-bit word and may be transmitted by radio, wire or infra-red link to the decoder at the train controller.

The serial data sent consists of one long sync pulse followed by eight pulses whose length is determined by whether the bit is at '1' or '0'. A short pulse is sent for 0 and a longer pulse for 1, but a gap is always left between bits to enable the counter in the decoder to step to the next bit.

All the pulses used in the encoder are derived from IC1 (Figure 4) whose mark/space ratio is set to give the critical 'on' period for data '1' transmissions. The output of this IC is fed to the decade counter (IC2) which serves two functions. The first is to select each one of the eight gates (IC3 and IC4) in their correct sequence and at the last two counts, send the sync pulse. The second function of IC2 is to provide sequential pulses to the speed control in decimal form at the same time as the binary counter (IC7) is counting up in binary.

When the decimal count reaches the selected speed, the binary data is clocked into the latch (IC6). The data held in this latch is sent at the appropriate time during the serial word's transmission. A simple diode encoder turns the information from the controller selector into the required two bits to be transmitted. Sync pulses and inter-word gaps are inserted by the gates (IC8) and the output is fed to the emitter follower (TR1).

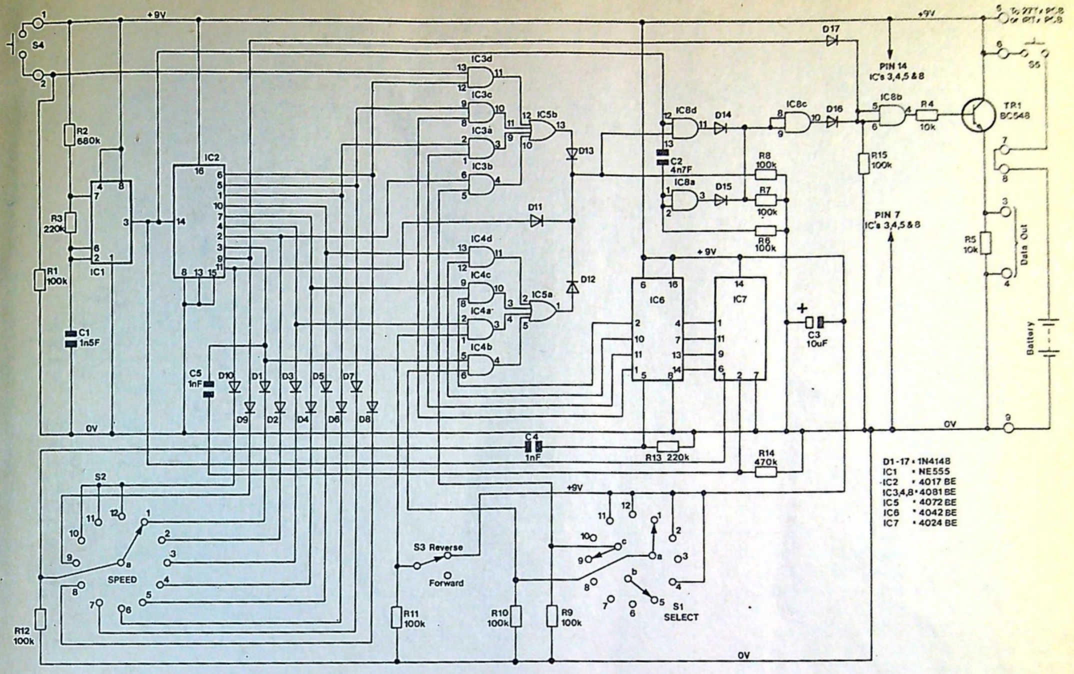


Figure 4a. Circuit diagram of Encoder board.

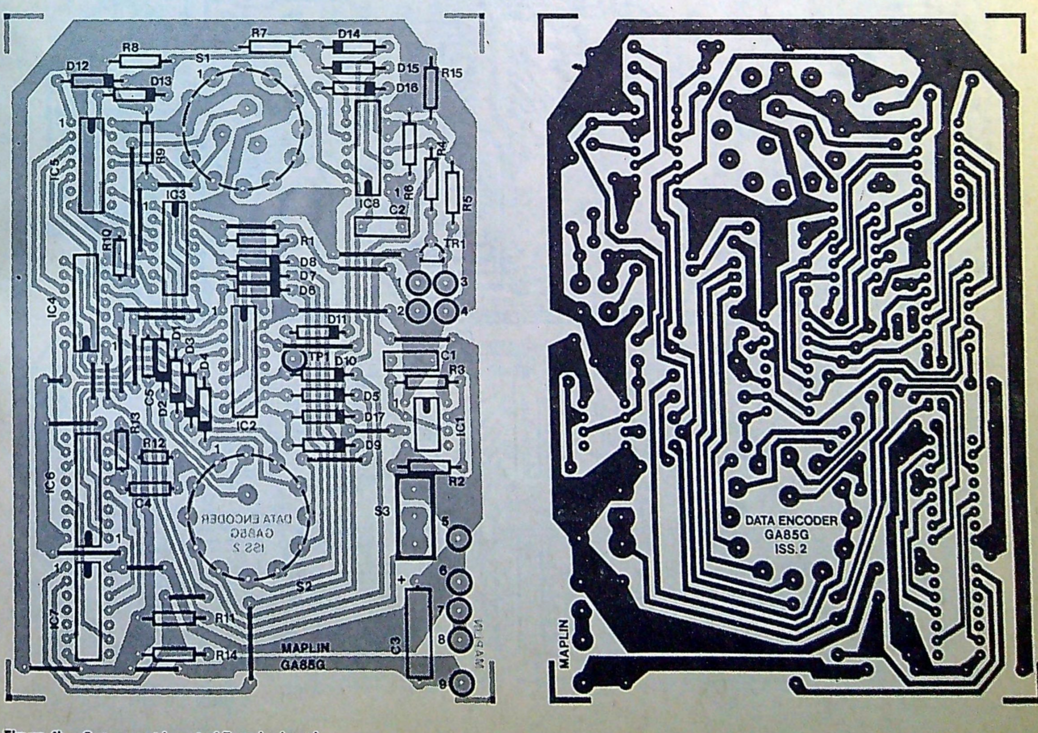


Figure 4b. Component layout of Encoder board.

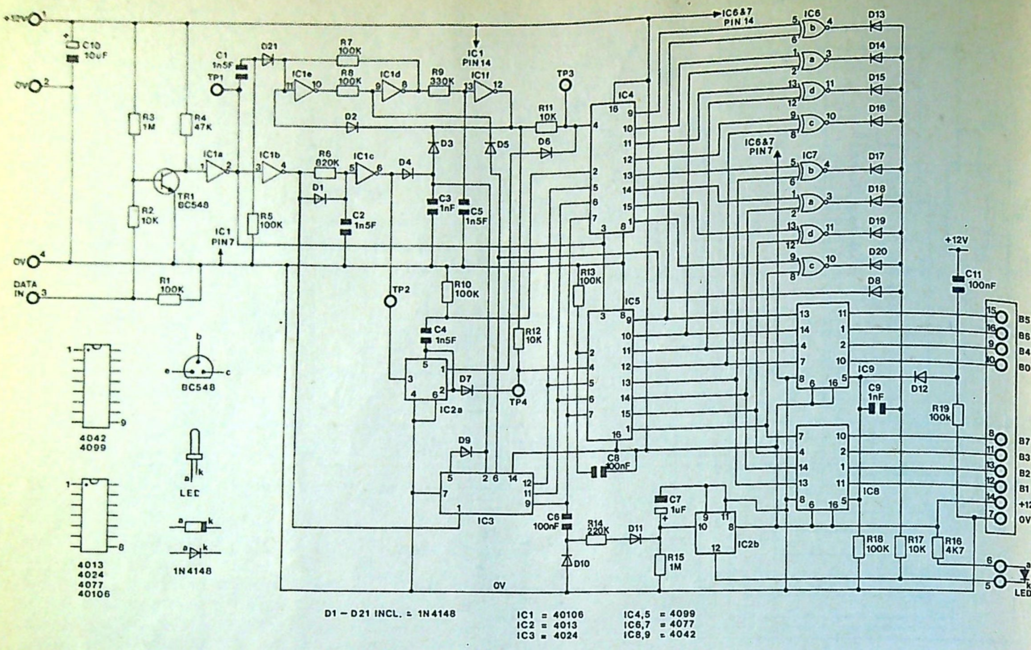
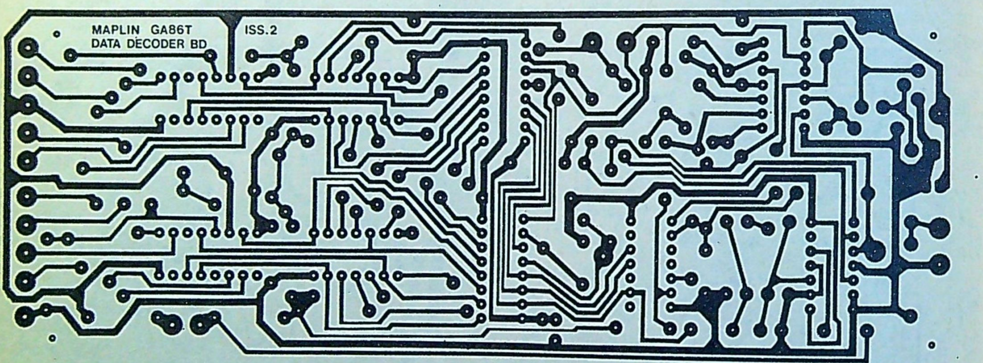


Figure 5a. Circuit diagram of Decoder board.



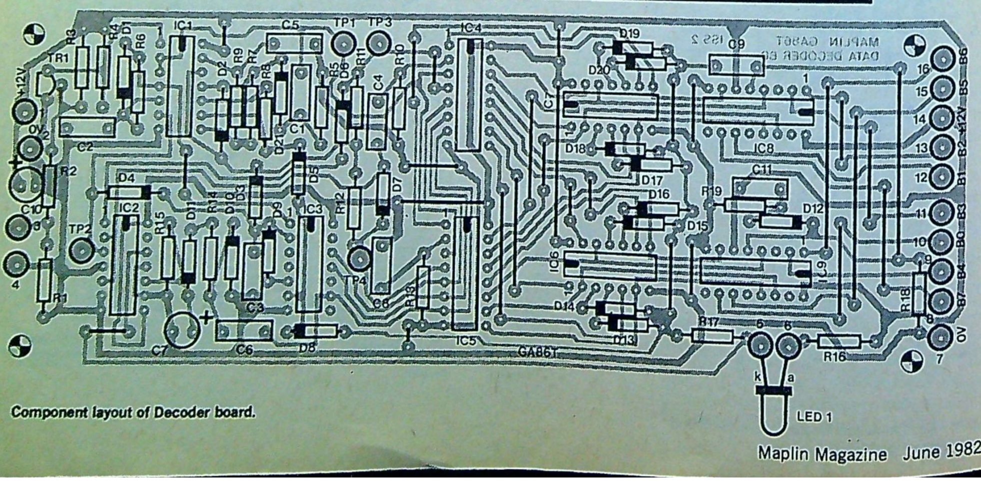
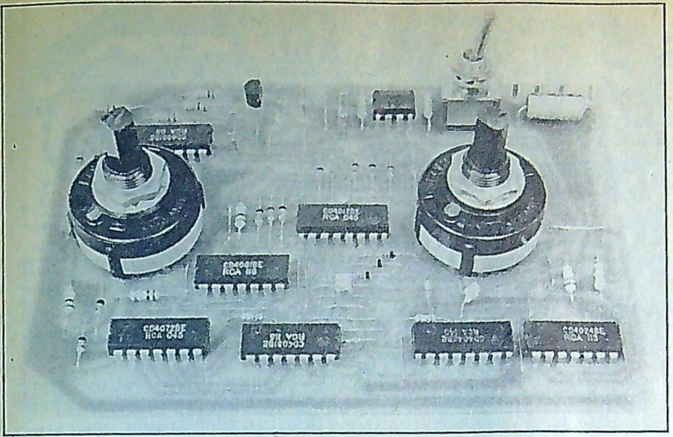
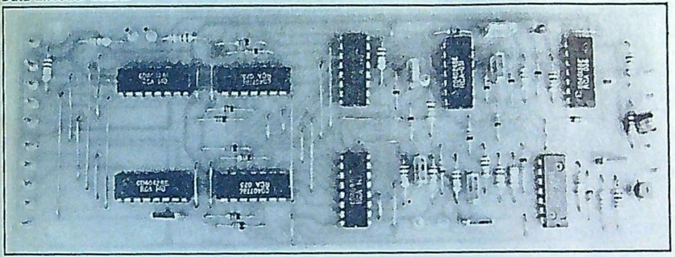


Figure 5b. Component layout of Decoder board.



Data Encoder board.



Data Decoder board.

Remote Control Data Decoder Board

The function of this board is to turn the serial information received from the encoder into a parallel 8-bit word. The system must check that the data received is correct and reject false signals caused by interference. This is done by comparing the data received in one word with the data received in the next word and clocking this data into the output latch only if both words are the same. A detector also monitors the output of the counter and if these pulses are not of the correct timing, the output latches are inhibited and no data transfer can occur.

The incoming signal is first buffered and amplified by TR1 (Figure 5) and then squared and inverted by the Schmitt trigger (IC1A). At this point, the signal should be the same as that leaving the remote encoder.

The signal is now split into three paths. The first is via IC1 B and C which forms a sync detecting unit, giving an output only after the incoming signal has remained at a high condition for the appropriate sync period. This sync pulse is used to reset the binary counter IC3 after it has completed its scan of the addressable latches. This binary counter is stepped by every positive transition of the input signal and its binary output is fed to the two addressable latches (IC4 and IC5); addressing each latch in the same sequence as the incoming bits of the serial signal.

The second path that the input signal can take is via C1. This produces a test pulse, a fixed time after each clocking pulse is received and this is used to enable the selected one of the two addressable latches which are also being fed with incoming data. If the input is high at the time of the test pulse, a '1' is clocked into the addressed latch and if the input is low, a '0' is clocked into the latch.

Each of the two latches is selected alternatively every frame and they are controlled by dividing the sync pulse rate by two in IC2 and using this to inhibit one or other of the latches. At the end of every two frames only one of the latches is cleared back to all low outputs.

The two sets of eight outputs from both latches are compared by the exclusive-NOR gates (IC6 and IC7) and when both latches contain the same data they allow a pulse to clock the data into the two 4-bit output latches (IC8 and IC9). This clock pulse is inhibited if the signal fail detection circuit sees an incorrect input pulse train.

Data Link

There are three methods of connecting the hand-held remote unit to the decoder located at the train controller. The simplest is to use a 2-wire cable which may be connected say, to several sockets located around the layout, to enable the remote unit to be plugged in wherever required.

The second method is by way of a 27MHz radio link and the third via an infra-red link.

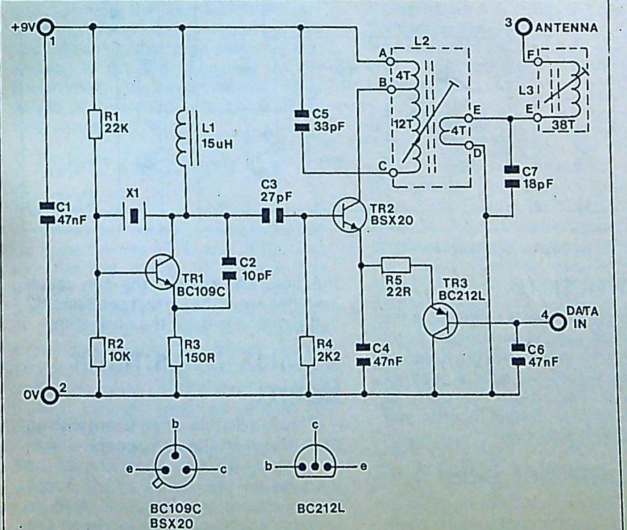


Figure 6a. Circuit diagram of 27MHz transmitter.

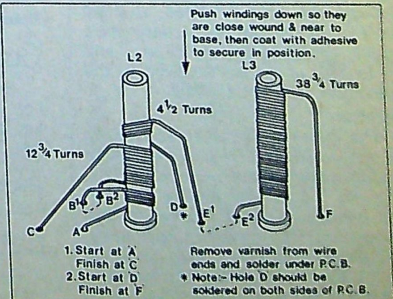

Push windings down so they are close wound & near to base, then coat with adhesive to secure in position.
L2
L3
$38\frac{3}{4}$ Turns
$4\frac{1}{2}$ Turns
$12\frac{3}{4}$ Turns
B1
B2
D
*
E1
E2
F
C
A
1. Start at 'A' Finish at 'C'
2. Start at 'D' Finish at 'F'
Remove varnish from wire ends and solder under P.C.B.
* Note:- Hole 'D' should be soldered on both sides of P.C.B.

Figure 6b. Coil winding details for 27MHz transmitter.

27MHz Radio Data Link

Transmitter

The transmitter is a low-powered 27MHz crystal-controlled circuit of fairly conventional design. TR1 forms an untuned crystal oscillator which runs all the time that the controller is in operation. The output of this oscillator is fed to the base of TR2 which acts as an output amplifier and modulator. Incoming data is fed to the base of TR3 whose emitter is connected to the emitter of TR2. Thus, when the data is low, TR2 is turned on and passes the rf signal to its collector and the aerial circuit and when the data is high TR2 and TR3 turn off and little or no rf is transmitted.

Receiver

This is built on a standard board designed for model control purposes. Due to the relatively short range required for this application, the rf amplifier in the receiver is not used and is strapped out. This reduces the effect of high levels of external interference. The local oscillator is crystal controlled at 455kHz below the incoming rf frequency and fed to the mixer where it meets the incoming signal from the aerial tuned circuit L1. The 455kHz intermediate frequency is amplified and fed to the detector (D1) via two tuned circuits (IFT1 and IFT2). The signal at the output of the detector is fed via C16 to the data decoder and its DC level is used for controlling the receiver gain (agc).

Licensing Requirements

Please note that a licence is no longer required to transmit and receive signals in the 27MHz band being used for model control. Since the radio link described here meets all the requirements for transmitters and receivers in this band, it is perfectly legal to use it without a licence. Indeed, a licence for this use is simply not available any more.

Infra-Red Data Link

Transmitter

IC1 forms an oscillator running at about 30kHz with a very short, but high amplitude, pulsed output. This output is used to switch TR2 and thus pass high current pulses of about ½A through the four infra-red emitting diodes (D2 to D5) for a very short period. These pulses are turned on and off by TR1 which is controlled by the data input from the encoder.

Receiver

The infra-red signal is received by the diodes D3 and D4 and the 30kHz modulated pulses are amplified by TR1 and TR2. D1 and D2 form a detector and provide a signal relative to the modulation. This signal is amplified by TR3 and any 30kHz is filtered out by its feedback circuit. This signal now feeds TR4 which forms an inverter and output stage.

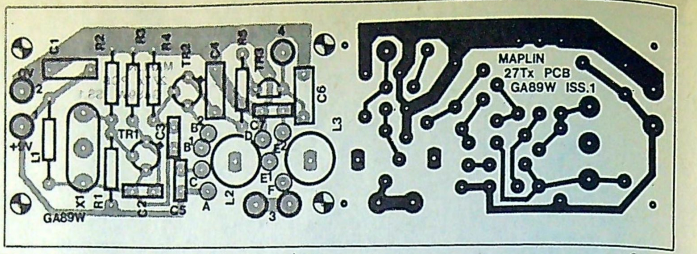
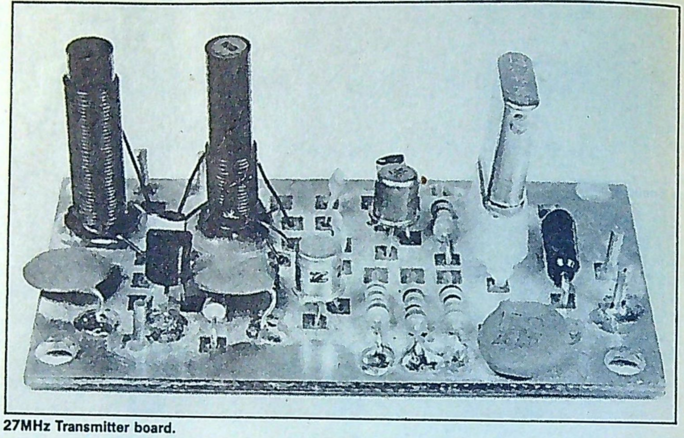


Figure 6c. Component layout of 27MHz transmitter board.



27MHz Transmitter board.

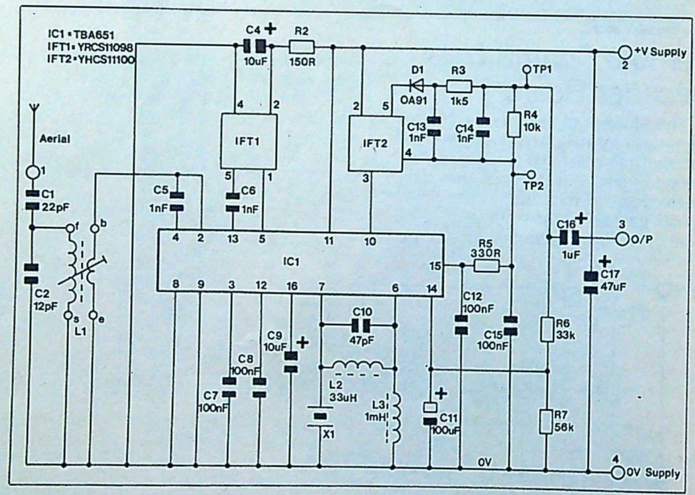


Figure 7a. Circuit diagram of 27MHz receiver.

Construction

Construct all boards referring to the board legend and the appropriate parts list, leaving the insertion of the IC's until last. Refer also to the special instructions below. Add the extra parts to whichever of the control boards you wish to control remotely.

Data Encoder Board

On this board, the Veropins have to be inserted from the component side to aid wiring when the board is mounted in the box. Ensure that the two rotary switches are in the correct positions. S2 is the switch without the click-stops.

27MHz Transmitter Board

This is a double-sided board with an earth-plane on the component side of the board. All the wires should be soldered on both sides of the board except where a clearance hole is provided for component leads on the earth plane side. Insert and glue the two

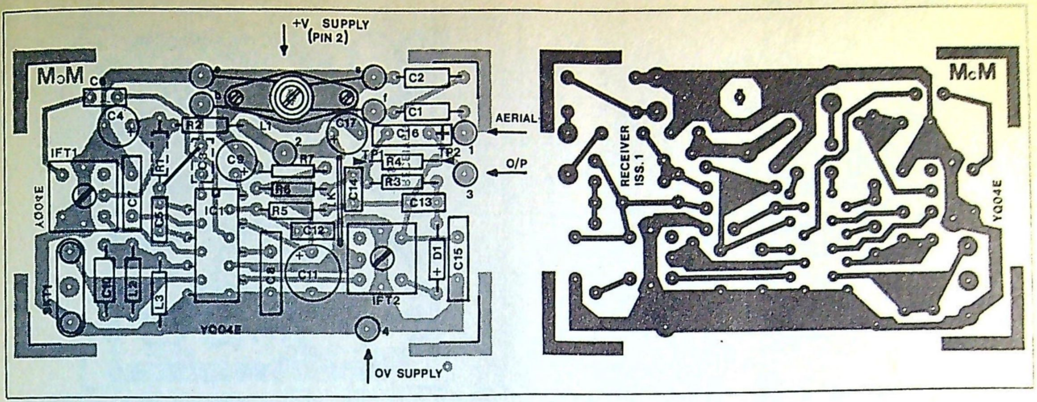
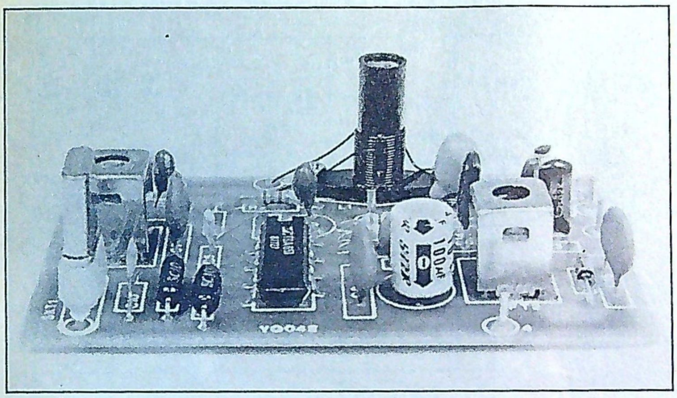


Figure 7b. Component layout of 27MHz receiver board.



27MHz Receiver board.

formers for L2 and L3 into the board and wind the coils using 28swg enamelled copper wire referring to Figure 6B.

Start the windings at points A and D and wind up the formers. When the windings are completed they should be fixed with cyanoacrylate adhesive and allowed to dry before setting up the transmitter. The aerial consists of a length of palladium wire about 45cm long connected to pins.

27MHz Receiver Board

Ensure correct positioning of the two i.f. transformers IFT1 and IFT2, and also the two chokes L2 and L3. The positive end of D1 is the end with the band. Note that R1 and C3 are not used in this application and are replaced with a link as shown in Figure 7B. An additional earth strap should be added under the board using a short length of tinned copper wire as shown in Figure 7C.

Wind the coil L1 referring to Figure 7D using 28swg enamelled copper wire. A length of tinned copper wire about 1.5cm long should be soldered to each end of R4 to form TP1 and TP2. The aerial is made from a length of palladium wire about 45cm long connected to pin 1 on the receiver board.

The crystals used in the transmitter and receiver must be a pair, though any colour will do. The crystal with the higher frequency is fitted in the transmitter. The receiver should be sited as far away from the layout as possible in order to reduce electrical interference problems.

Infra-red Receiver

The positioning of the infra-red receiver diodes will affect the range of the system. They should be shielded from direct light both artificial and sunlight. A simple reflector behind the diodes and a lens system will improve the range. Nevertheless, a range of about 6 metres can be expected with no additions with the transmitter pointing directly at the receiver diodes. The receiver must be mounted in a metal box with the box connected to 0V, otherwise the very sensitive circuit will pick up radio interference.

Setting-up 27MHz Transmitter & Receiver

Transmitter

Construct the rf monitor as shown in Figure 8a and connect to a suitable

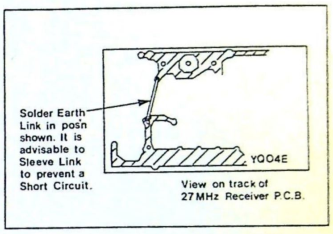

Solder Earth Link in posn shown. It is advisable to Sleeve Link to prevent a Short Circuit.
YQ04E
View on track of 27MHz Receiver P.C.B.

Figure 7c. Addition of earth link to 27MHz receiver board.

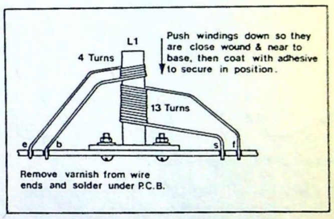

L1
4 Turns
Push windings down so they are close wound & near to base, then coat with adhesive to secure in position.
13 Turns
e
b
s
f
Remove varnish from wire ends and solder under P.C.B.

Figure 7d. Coil winding details for 27MHz receiver.

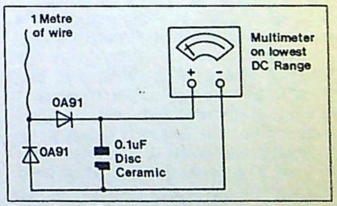


Figure 8a. RF monitor for transmitter alignment.

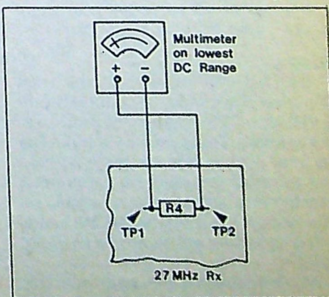


Figure 8b. Meter connections for receiver alignment.

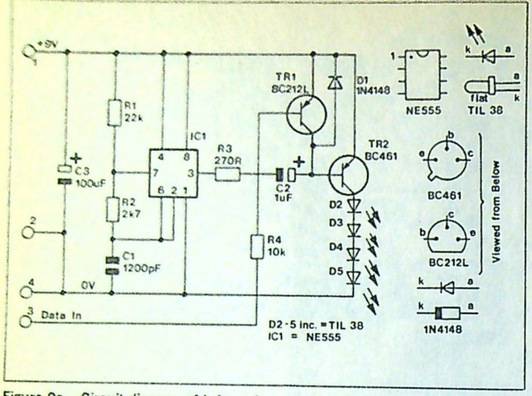


Figure 9a. Circuit diagram of Infra-red transmitter.

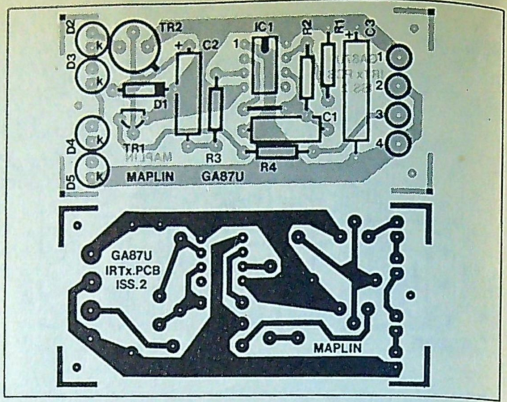
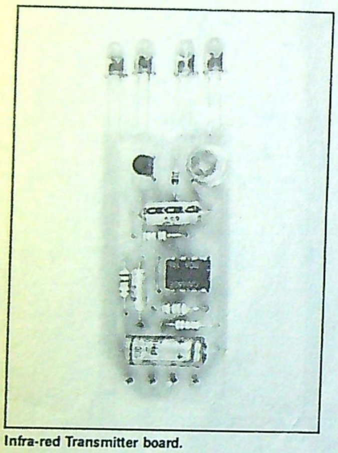


Figure 9b. Component layout of Infra-red transmitter board.



Infra-red Transmitter board.

meter. Install the battery in the hand-held controller and hold the aerial near the wire attached to the monitor. When the transmit button is pressed, a reading should be obtained on the meter. Adjust L2 for maximum reading.

Move the aerial away from the monitor wire until a reading is just present and adjust L3 for maximum reading. Keep moving the aerial further away until a peak setting is found at the greatest distance away from the monitor wire. The controller should be held in a position as near as possible to that in which it will be used during the setting up of L3 to obtain maximum output under working conditions.

Receiver

Connect the receiver to the train controller and connect a suitable meter to TP1 and TP2 (Figure 8b) on the receiver board. Temporarily short out the transmit push button on the hand-held unit in order to provide a continuous transmitted signal. A reading should be obtained on the meter when the hand-held unit is brought near the receiver aerial.

Move the transmitter away until the reading on the meter falls and then adjust L1, T1 and T2 in turn for

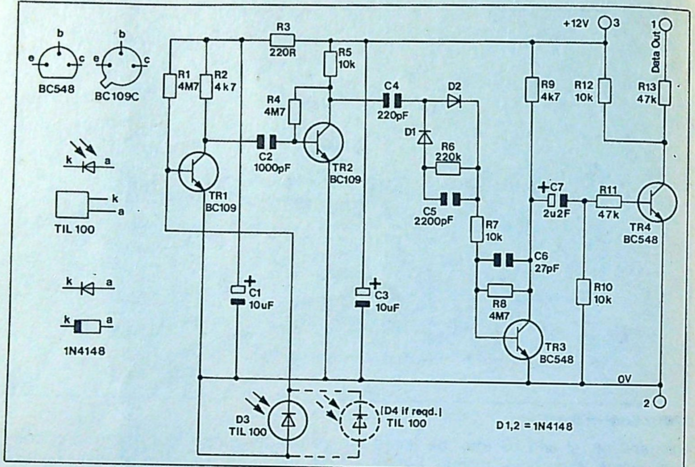


Figure 10a. Circuit diagram of Infra-red receiver.

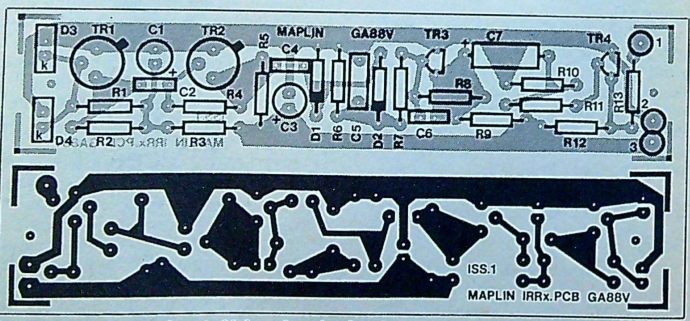
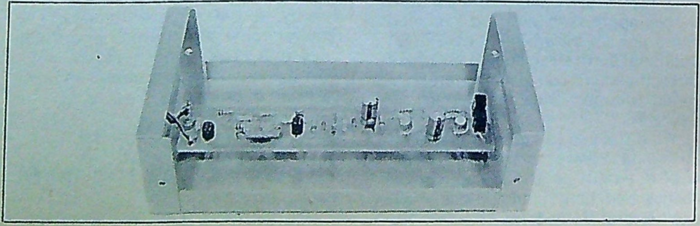


Figure 10b. Component layout of Infra-red receiver board.



Infra-red Receiver board.

CONTROL CODE CHART	SPEED	DIRECTION	CODE No.		SPEED	DIRECTION	CODE No.
CONTROL BD 1	0 ↓ 10	Forward	0 ↓ 10	CONTROL BD 2	0 ↓ 10	Forward	32 ↓ 42
	0 ↓ 10	Reverse	16 ↓ 26		0 ↓ 10	Reverse	48 ↓ 58
CONTROL BD 3	0 ↓ 10	Forward	64 ↓ 74	CONTROL BD 4	0 ↓ 10	Forward	96 ↓ 106
	0 ↓ 10	Reverse	80 ↓ 90		0 ↓ 10	Reverse	112 ↓ 122

Figure 11. Table of decimal codes for control functions.

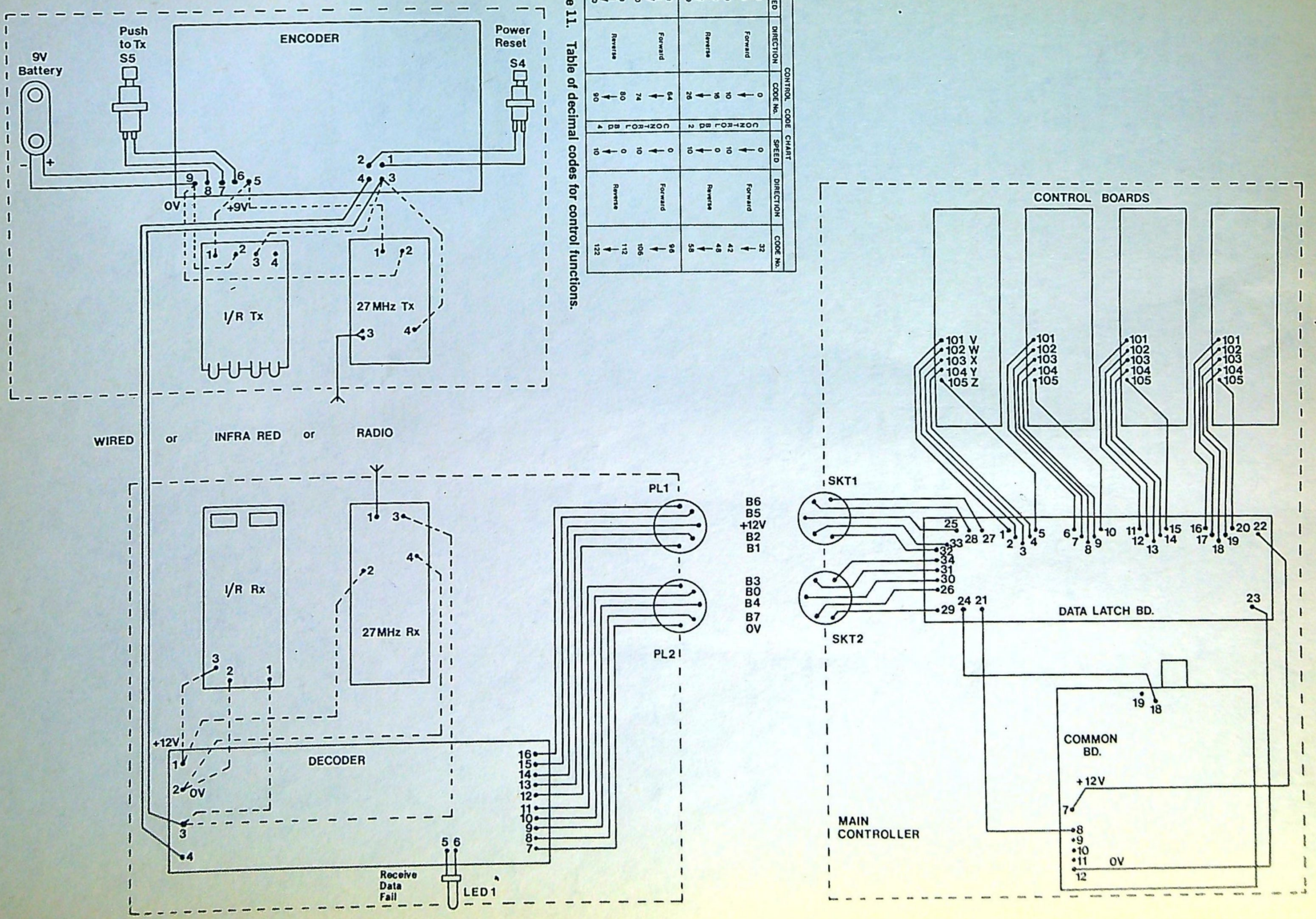


Figure 12. Interwiring diagram.

maximum reading. Keep moving the hand-held unit further away and retuning the receiver until a maximum reading is obtained at the greatest distance. A good reading should be obtained with the transmitter at least 7 metres away from the receiver. Disconnect the temporary link on the transmitter and the system should now be ready for use.

Remote Control Operation

Select the train or trains to be controlled on the train controller and switch the appropriate control boards to 'Remote'. The control board to be commanded may now be selected on the remote unit. Press the transmit button and set the speed and direction of the train as required. Note that there is a short delay of about 1 second before the decoder decides a valid signal is being received, but after this initial delay all information is transferred immediately.

The selected train may be left running and another controlled by first releasing the transmit button and then selecting the next train, pressing the transmit button and controlling the speed and direction of the new train. This process can be repeated until all four control boards are in use.

In the event of the power protection circuit being tripped, it may be reset by first pressing the transmit button, then pressing the reset button on the hand-held unit. This facility may also be used as an emergency stop by releasing the transmit button before the reset button. The power will remain off until a new command is sent. Note that this condition overrides the manual reset control on the train controller, but it may be reset from that end by turning the mains switch off for about 10 seconds before re-applying power.

When using the 27MHz link it should be noted that there is a minimum distance of about 2 metres where the transmitter will overload the receiver and no data will be transferred.

Computer Control

The 8-bit digital input may be fed from any computer via a suitable interface unit. An interface for the ZX81 will be described in our next issue. If the binary word required to control the system is converted into decimal form, programming is accomplished as follows.

The starting number for each of the four control boards is:

0 for Control Board 1
32 for Control Board 2
64 for Control Board 3
and 96 for Control Board 4

To control the forward speed of each board, add a number from 0 to 10 inclusive to the starting number. Zero is minimum speed and 10 is maximum speed. For the reverse direction, add 16 to the starting number and then add a further 0 to 10 to control the speed.

Power reset or 'all stop' may be accomplished by using the number 128. Note that as each train is controlled, the last data sent for that train is held in the associated latch, so to stop all trains, it is necessary to enter the four numbers 0, 32, 64 and 96. It does not matter in which direction the trains are travelling at the time the command is given.

The inertia or speed-up and slow-down rate of each train may be written into the program by arranging for the time taken to step up from zero to the required speed and back to zero to be varied. By using the input ports, the train controller can be made to control the speed of the train dependent on its position on the layout. Future articles will describe suitable detectors and interfacing for this and computer control of signals and points.

PARTS LIST OF ADDITIONS TO CONTROL BOARD FOR REMOTE CONTROL OR COMPUTER CONTROL (1)

Resistors — all ⅓W 5% carbon			
R101 to 104	100k	4 off	(M100K)
R105	4k7		(M4K7)
Semiconductors			
D101	1N4148		(QL80B)
IC101	4024BE		(QX13P)
IC102	4063BE		(QW41U)
Miscellaneous			
S101	Sub-min toggle 2-pole		(FH04C)
	Veropin 2141	5 off	(FL21X)

Note. Links 'A' and 'B' must be removed from pcb.

DATA LATCH PARTS LIST (2)

Resistors — all ⅓W 5% carbon			
R1,9 to 12	10k	5 off	(M10K)
R2 to 8	22k	7 off	(M22K)
R13	100k		(M100K)
Capacitors			
C1	1uF 100V pc electrolytic		(FF01B)
C2	10uF 35V pc electrolytic		(FF04E)
Semiconductors			
D1 to 9	1N4148	9 off	(QL80B)
TR1	BC548		(QB73Q)
IC1 to 4	40174BE		(QW73Q)
IC5	40106BE		(QW64U)
Miscellaneous			
SK1	DIN socket 5-pin A		(HH34M)
SK2	DIN socket 5-pin B		(HH35Q)
	Remote data latch pcb		(GA84F)
	Veropin 2141	34 off	(FL21X)

27MHz DATA RECEIVER PARTS LIST (8)

Resistors — all ⅓W 5% carbon			
R1	Not used		
R2	150R		(M150R)
R3	1k5		(M1K5)
R4	10k		(M10K)
R5	330R		(M330R)
R6	33k		(M33K)
R7	56k		(M56K)
Capacitors			
C1	22pF ceramic		(WX48C)
C2	12pF ceramic		(WX45Y)
C3	Not used		
C4,9	10uF 16V tantalum	2 off	(WW68Y)
C5,6	1nF ceramic	2 off	(WX68Y)
C7,8,12,15	100nF disc ceramic	4 off	(BX03D)
C10	47pF ceramic		(WX52G)
C11	100uF 10V pc electrolytic		(FF10L)
C13,14	1nF mylar	2 off	(WW15R)
C16	1uF 35V tantalum		(WW60Q)
C17	47uF 10V tantalum		(WW75S)
Semiconductors			
D1	OA91		(QH72P)
IC1	TBA651		(BL35Q)
Miscellaneous			
L1	Former 351		(LB17T)
	Dust core type 6		(LB42V)
	Enamelled copper wire 28swg		(BL39N)
L2	Choke 33uH		(WH38R)
L3	Choke 1mH		(WH47B)
IFT1	YRCS 11098		(HX42V)
IFT2	YHCS11100		(HX43W)
X1	Crystal		(see transmitter)
SKT1	Crystal socket		(HX60Q)
	Bolt 8BA ¼in.	2 off	(BF08J)
	Nut 8BA	2 off	(BF19V)
	Washer 8BA	2 off	(BF23A)
	27MHz receiver pcb		(YQ04E)

DATA DECODER PARTS LIST (3)

Resistors — all ⅓W 5% carbon			
R1,7,8,10,13,18,19	100k	7 off	(M100K)
R2,11,12,17	10k	4 off	(M10K)
R3,15	1M	2 off	(M1M)
R4,5	47k	2 off	(M47K)
R6	820k		(M820K)
R9	330k		(M330K)
R14	220k		(M220K)
R16	820R		(M820R)
Capacitors			
C1,2,4,5	1.5nF polycarbonate	4 off	(WW23A)
C3,9	1nF polycarbonate	2 off	(WW22Y)
C6,8,11	100nF polycarbonate	3 off	(WW41U)
C7	1uF 35V tantalum		(WW60Q)
C10	10uF 35V pc electrolytic		(FF04E)
Semiconductors			
D1 to 21	1N4148	21 off	(QL80B)
LED1	Red LED		(WL27E)
TR1	BC548		(QB73Q)
IC1	40106BE		(QW64U)
IC2	4013BE		(QX07H)
IC3	4024BE		(QX13P)
IC4,5	4099BE	2 off	(QW57M)
IC6,7	4077BE	2 off	(QW47B)
IC8,9	4042BE	2 off	(QX19V)
Miscellaneous			
PL1	DIN plug 5-pin A		(HH27E)
PL2	DIN plug 5-pin B		(HH28F)
	Data decoder pcb		(GA86T)
	Veropin 2141	20 off	(FL21X)

DATA ENCODER PARTS LIST (4)

Resistors — all ⅓W 5% carbon unless specified			
R1,6,7,8,9,11,15	100k	7 off	(M100K)
R2	680k		(M680K)
R3	220k		(M220K)
R4,5*	10k	2 off	(M10K)
R10,12	100k (½W)	2 off	(U100K)
R13	220k (½W)		(U220K)
R14	470k		(M470K)
Capacitors			
C1	1.5nF polycarbonate		(WW23A)
C2	4.7nF polycarbonate		(WW26D)
C3	10uF 25V axial electrolytic		(FB22Y)
C4,5	1nF ceramic	2 off	(WX68Y)
Semiconductors			
D1 to 17	1N4148	17 off	(QL80B)
TR1	BC548		(QB73Q)
IC1	NE555		(QH66W)
IC2	4017BE		(QX09K)
IC3,4,8	4081BE	3 off	(QW48C)
IC5	4072BE		(QX27E)
IC6	4042BE		(QX19V)
IC7	4024BE		(QX13P)
Miscellaneous			
S1	Rotary switch 3 pole 4 way		(FH44X)
S2	Switchpot 1 pole 12 way		(XX45Y)
S3	Sub-min toggle 'A'		(FH00A)
S4	Push switch		(FH59P)
S5	Press switch		(FH91Y)
	Knob K7B (for S1)		(YX02C)
	Knob K7C (for S2)		(YX03D)
	Battery clip		(HF28F)
	PP3 battery		—
	Data encoder pcb		(GA85G)
	Veropin 2141	10 off	(FL21X)

*If this is to be used with the 27MHz data link then make R5 a Min Res 1k even if you are using IR or wired links as well.

To make the function shown below, you will require all the parts shown in the parts list indicated.

Computer interface : 1, 2.
Wired remote control : 1, 2, 3, 4.
Infra-red remote control : 1, 2, 3, 4, 5, 6.
Radio remote control : 1, 2, 3, 4, 7, 8.

Note that parts list 1 will be required for each control board that you wish to modify.

As there are so many possible different combinations of these parts, it is not possible to offer kits.

INFRA-RED TRANSMITTER PARTS LIST (5)

Resistors — all ⅓W 5% carbon			
R1	22k		(M22K)
R2	2k7		(M2K7)
R3	270R		(M270R)
R4	10k		(M10K)
Capacitors			
C1	1200pF 1% polystyrene		(BX57M)
C2	1uF 63V axial electrolytic		(FB12N)
C3	100uF 10V axial electrolytic		(FB48C)
Semiconductors			
D1	1N4148		(QL80B)
D2 to 5	TIL38	4 off	(YH70M)
TR1	BC212L		(QB60Q)
TR2	BC461		(QB72P)
IC1	NE555		(QH66W)
Miscellaneous			
	Infra-red transmitter pcb		(GA87U)
	Veropin 2141	4 off	(FL21X)

INFRA-RED RECEIVER PARTS LIST (6)

Resistors — all ⅓W 5% carbon			
R1,4,8	4M7	3 off	(M4M7)
R2,9	4k7	2 off	(M4K7)
R3	220R		(M220R)
R5,7,10,12	10k	4 off	(M10K)
R6	220k		(M220K)
R11,13	47k	2 off	(M47K)
Capacitors			
C1,3	10uF 35V pc electrolytic	2 off	(FF04E)
C2	1000pF ceramic		(WX68Y)
C4	220pF ceramic		(WX60Q)
C5	2200pF polycarbonate		(WW24B)
C6	27pF ceramic		(WX49D)
C7	2.2uF 63V axial electrolytic		(FB15R)
C8	100nF 35V tantalum		(WW54J)
Semiconductors			
D1,2	1N4148	2 off	(QL80B)
D3 (D4 if req'd)	TIL100		(YH71N)
TR1,2	BC109C	2 off	(QB33L)
TR3,4	BC548	2 off	(QB73Q)
Miscellaneous			
	Infra-red receiver pcb		(GA88V)
	Veropin 2141	3 off	(FL21X)

27MHz DATA TRANSMITTER PARTS LIST (7)

Resistors — all ⅓W 5% carbon			
R1	22k		(M22K)
R2	10k		(M10K)
R3	150R		(M150R)
R4	2k2		(M2K2)
R5	22R		(M22R)
Capacitors			
C1,4,6	47nF disc ceramic	3 off	(BX02C)
C2	10pF ceramic		(WX44X)
C3	27pF ceramic		(WX49D)
C5	33pF ceramic		(WX50E)
C7	18pF ceramic		(WX47B)
Semiconductors			
TR1	BC109C		(QB33L)
TR2	BSX20		(QF32K)
TR3	BC212L		(QB60Q)
Miscellaneous			
L1	Choke 15uH		(WH36P)
L2,3	Former 722/2	2 off	(LB20W)
	Dust Core	2 off	(LB41U)
	Enamelled copper wire 28swg	½m	(BL39N)
X1	Crystal (supplied in pairs) (any one of HX30H to HX35Q)		
	Crystal socket		(HX60Q)
	27MHz transmitter pcb		(GA89W)
	Veropin 2141	3 off	(FL21X)

PRICE LIST

All prices shown in this price list are valid from 17th May 1982 to 14th August 1982

Please note new telephone number for Sales Only (0702) 552911

Prices shown in this list include VAT at 15% where applicable. Items marked *NV* are rated at 0% and the price shown applies both to inland and export orders. Overseas customers should add up the total cost of all items except those marked *NV* and deduct 13% to arrive at the total price excluding VAT. Alternatively multiplying the total price (except *NV* items) by 0.87 will give the total price excluding VAT. Please add extra for carriage on all overseas orders. Carriage will be charged at cost.

Although postage charges to customers living in the Republic of Ireland and in the UK, but not on the UK mainland, are the same as to mainland addresses we regret that we must levy an additional charge of £5 on each order containing any items marked "Delivery by Carrier".

Will customers from the Republic of Ireland please add 40p and then 35% to the cost of their order now that the Irish pound is not equivalent to sterling, to cover the rate difference and negotiation fees. We will refund any difference; please state cheque or credit note. Alternatively if you pay by bank draft drawn in pounds sterling on a London bank, then you need add nothing extra. Bank drafts drawn in pounds sterling on a London bank should be readily available from your local bank.

All prices are for the unit quantity shown in the catalogue (unless shown otherwise on this list) i.e. each, per pack, per metre etc. All prices include postage and packing. There is a 30p handling charge which must be paid on all orders having a total value of under £4.00.

The price list is intended for use with our 1981 catalogue and applies to all mail orders. Prices in our shop are generally lower on heavy items as mail order prices include postage and packing costs.

Copies of manufacturers' data sheets are available for most IC's — price 40p each.

Notes:

NYA	Not yet available
NA	Not available
DIS	Discontinued
TEMP	Temporarily out of stock
OOP	Out of print
FEB	Out of stock, new stock expected in month shown
†	While stocks last
*	Item is mentioned in "Amendments to Catalogue" elsewhere in this newsletter
NV	Indicates that item is zero rated for VAT purposes
■	Price reduced

Prices charged will be those ruling on the day of despatch

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TS08J	Parts T Shirt LC	DIS
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XF30H	Pirate Attack Poster	£1.00*NV*
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XQ25C	Mushkiller FM244T	£17.80
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XQ44X	ExtragainXG14 GroupB	£36.35
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BW44X	Mast Bracket Type 14	£4.65
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RQ07H	Book Sybex L3	DIS
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LH59P	Potting Box Large	28p
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LH14Q	Box PB1 Grey	TEMP
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LH21X	ABS Box MB2	£1.20
LH22Y	ABS Box MB3	£1.45
LH23A	ABS Box MB4	£3.25
WY03D	ABS Box 2002	£1.15
LH60Q	ABS Box 2004	£1.60
LH61R	ABS Box 2005	£1.90
LH62S	ABS Box 2006	£3.35
LH63T	ABS Console M1005	£2.40
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LH65V	ABS Console M6005	£2.75
LH66W	ABS Console M6006	£3.55
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LH69A	ABS Console M8007	£6.85
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WY01B	Metal Panel Bx M4004	£1.85
WY02C	Metal Panel Bx M4005	£2.65
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LH09K	Foot Sw Box	£3.95■
LF03D	Box PB301	£1.85

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LL01B	Verobox 104	£13.95
LL02C	Verobox 105	£6.39
LL03D	Verobox 106	£3.25
LL04E	Verobox 107	£3.55
LL05F	Verobox 201	£5.35
LL06G	Verobox 202	£6.75
LL07H	Verobox 203	£8.50
LL08J	Verobox 211	£4.35
LL09K	Verobox 212	£4.85■
LL10L	Verobox 213	£5.49
LQ07H	Verobox 214	£5.25
LQ08J	Verobox 215	£5.95
LQ09K	Verobox 216	£6.25
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LH25C	Verobox 222	£4.95
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LL12N	Verobox 301	68p
LL13P	Verobox 302	68p
LH50E	Verobox 303	£1.45
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LL14Q	Verobox 401	£1.10
XB88V	Verocase 501	£15.95
XB89W	Verocase 502	£29.95
XY15R	Verobox 503	£15.95
LQ03D	Flip-Top Box 601 Blk	£3.55
LQ05F	Flip-Top Box 602 Blk	£5.25
LH27E	Verobox 701	£5.35
LH28F	Verobox 702	£5.55
LH29G	Verobox 704	£8.25
LH30H	Verobox 705	£7.25
LH31J	Verobox 707	DIS
LH32K	Verobox 708	DIS
LH33L	Verobox 713	DIS
LH34M	Verobox 716	DIS
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LF09K	Box AB8	£1.25
LF10L	Box AB9	£1.15
LF11M	Box AB10	£1.35
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LF13P	Box AB12	90p
LF14Q	Box AB13	£1.65
XB71N	Box AB15	£3.25
LF15R	Box AB23	£1.65
LF16S	Box AB24	£1.75
LH10L	Box AB28	£1.50
XB69A	Box AB31	£2.25
XB56L	Chassis AC64	£2.10
XB68Y	Chassis AC86	£3.25
LF02C	Case WB1 Vinyl	£1.99
LH37S	Case WB2 Vinyl	£2.80
LH38R	Case WB3 Vinyl	£3.45
LH39N	Case WB4 Vinyl	£3.95
LH40T	Case WB5 Vinyl	£5.35
LH41U	Case WB6 Vinyl	£6.55
LH42V	Case WB7 Vinyl	£6.95
LH43W	Case TP1 Teak	£1.85
LH44X	Case TP2 Teak	£2.85
LH45Y	Case TP3 Teak	£3.55
LH46A	Case TP4 Teak	£4.20
LH47B	Case TP5 Teak	£5.35
LH48C	Case TP6 Teak	£6.45
LH70M	Box DCM5002	£2.40
LH71N	Box DCM5004	£3.25
LH72P	Box DCM5007	£4.55
LH73Q	Box DCM5005	£4.40
LH74R	Box DCM5006	£5.75
XQ08J	G-Range 2A	£10.95
XQ09K	G-Range 3G	£14.40
XQ10L	G-Range 4B	£21.95

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XY61R	Centurion DX1	£6.95
XY62S	Centurion DX2	£7.85
XY63T	Centurion DX3	£8.65
XY64U	Centurion WX3	£11.95
XY65V	Centurion WX4	£13.25
XY66W	Centurion DX4	£9.85
XY67X	Centurion DX5	£10.45
XY68Y	Centurion DX6	£11.95
XY69A	Centurion WX1	£14.65
XY70M	Centurion WX2	£14.95
XQ11M	Centurion EX1H	£12.74
XQ12N	Centurion EX2H	£13.85
XQ13P	Centurion EX3H	£14.95
XQ14Q	Centurion EX4H	£16.50
XY59P	Console 103	£10.95
XY60Q	Console 108	£16.45

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XB73Q	Blue Case 227	£4.55
XY40T	Blue Case 230	£4.95
XY41U	Blue Case 235	£5.40
XY42V	Blue Case 209	£4.65
XY43W	Blue Case 212	£5.35
XY44X	Blue Case 231	£5.95
XB67X	Blue Case 236	£6.45
XY45Y	Blue Case 222	£5.85
XY46A	Blue Case 226	£6.85
XB70M	Blue Case 232	£6.45
XY47B	Blue Case 237	£7.90
XY48C	Blue Case 233	£7.70
XY49D	Blue Case 238	£9.80
XY50E	Wood-End Case 625	£10.45
XY51F	Wood-End Case 635	£11.45
XY52G	Wood-End Case 645	£12.30
XY53H	Wood-End Case 926	£13.90
XY54J	Wood-End Case 936	£14.95
XY55K	Wood-End Case 947	£16.50
XY56L	Wood-End Case 1426	£13.95■
XY57M	Wood-End Case 1437	£18.95
XY58N	Wood-End Case 1449	£22.80
XY38R	19 in. Card Frame	£38.50
XY39N	19 inch Frame Case	£24.95
YR49D	3E Front Panel	£4.25
YR50E	6E Front Panel	£4.65
YR51F	12E Front Panel	£5.45
YR52G	24E Front Panel	£7.35

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LH52G	3E Module	£6.49
LH53H	6E Module	£6.79
LH54J	12E Module	£9.93
LH55K	24E Module	£14.93
YR54J	Eurocard Guide	22p
YR55K	Mod Int Card Guide	22p
FW19V	Feet Cab	8p

1981 Catalogue Page No.		VAT inclusive PRICE
FW38R	Stick-on Feet	18p
FW39N	HD Feet	10p
HH23A	Recess Plate	8p
YR53H	Card Frame Brackets	50p
YR56L	Card Frame Heat Sink	£1.69
FX96E	Castors	£2.75
FX05F	Castor Cup	49p
XY31J	Piano Legs	£24.50

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FX06G	Cool Grille	35p
FW81C	Handle	64p
FW82D	HD Strap Handle	£1.55
FX03D	Inst Handle PLastic	59p
FX00A	Inst Handle Small	£2.68
FX01B	Inst Handle Large	£2.75
FX02C	Ferrule	31p
LH08J	Recess Handle	43p
LH11M	Heavy Duty Handle	£2.59
YL05F	Flip Handle	£4.95
YX00A	Cab Corners Small	20p
FX04E	Cab Corner Large	12p
FX94C	Corner Two-Side	29p
FX95D	Corner Three-Side	36p
HB20W	Flexihinge	8p
YL24B	Small Hinge	£1.55

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YL04E	Lift off Hinge	£1.85
YL25C	Lockable Catch	£2.15
YL06G	Butterfly Catch	£4.79
★XY17T	Laminate Japan Teak	£3.75
★XY18U	Laminate Penang W/Nu	£3.75
XY19V	Laminate Alum Small	£1.59
XY20W	Laminate Alum Large	£2.11
RY00A	Black Tygan 45in.	£1.96
RY01B	Black Tygan 22.1/2in.	98p
RY02C	Brown Tygan 45in.	£1.96
RY03D	Brown Tygan 22.1/2in.	98p
RY04E	Covering Cloth 50in.	£1.06
RY05F	Covering Cloth 25in.	53p
RY06G	Acoustic Wadding	65p

CABLES

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BL77J	Wire-Wrap Black	£1.85
BL78K	Wire-Wrap Blue	£1.85
BL79L	Wire-Wrap Green	£1.85
BL80B	Wire-Wrap Natural	DIS
BL81C	Wire-Wrap Orange	£1.85
BL82D	Wire-Wrap Red	£1.85
BL83E	Wire-Wrap White	£1.85
BL84F	Wire-Wrap Yellow	£1.85
BL85G	Bell Wire Black	50p
BL86T	Bell Wire Blue	50p
BL87U	Bell Wire Brown	50p
BL88V	Bell Wire Green	50p
BL89W	Bell Wire Grey	50p
BL90X	Bell Wire Orange	50p
BL91Y	Bell Wire Pink	50p
BL92A	Bell Wire Red	50p
BL93B	Bell Wire Violet	50p
BL94C	Bell Wire White	50p
BL95D	Bell Wire Yellow	50p
BL46A	L/C Wire Black	£1.18
BL47B	L/C Wire Blue	£1.18
BL48C	L/C Wire Brown	£1.18
BL49D	L/C Wire Green	£1.18
BL50E	L/C Wire Grey	£1.18
BL51F	L/C Wire Orange	£1.18
BL52G	L/C Wire Pink	£1.18
BL53H	L/C Wire Red	£1.18
BL54J	L/C Wire Violet	£1.18
BL55K	L/C Wire White	£1.18
BL56L	L/C Wire Yellow	£1.18
BL00A	Wire 10M Black	35p
BL01B	Wire 10M Blue	35p
BL02C	Wire 10M Brown	35p
BL03D	Wire 10M Green	35p
BL04E	Wire 10M Grey	35p
BL05F	Wire 10M Orange	35p
BL06G	Wire 10M Pink	35p
BL07H	Wire 10M Red	35p
BL08J	Wire 10M Violet	35p
BL09K	Wire 10M White	35p
BL10L	Wire 10M Yellow	35p
XL10L	Wire 11C	£3.75
YR00A	Bicol Green/Red	34p
YR01B	Bicol Green/Yellow	34p
YR02C	Bicol Grey/Black	34p
YR03D	Bicol Grey/Blue	34p
YR04E	Bicol Orange/Black	34p
YR05F	Bicol Orange/Red	34p
YR06G	Bicol Pink/Black	34p
YR07H	Bicol Purple/Red	34p
YR08J	Bicol Red/Black	34p
YR09K	Bicol Red/Blue	34p
YR10L	Bicol Red/Brown	34p
YR11M	Bicol Red/Green	34p
YR12N	Bicol White/Black	34p
YR13P	Bicol White/Red	34p
YR14Q	Bicol Yellow/Black	34p
YR15R	Bicol Yellow/Green	34p
YR16S	Bicol Yellow/Red	34p
XR32K	Wire 3202 Black	17p
XR33L	Wire 3202 Blue	17p
XR34M	Wire 3202 Brown	17p
XR35Q	Wire 3202 Green	17p
XR36P	Wire 3202 Red	17p
XR37S	Wire 3202 White	17p
XR38R	Wire 3202 Grn/Yllw	17p

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XR57M	HC Wire Black	38p
XR58N	HC Wire Green	38p
XR59P	HC Wire Red	38p
XR40T	Extra Flex Black	16p
XR41U	Extra Flex Blue	16p
XR43W	Extra Flex Green	16p
XR44X	Extra Flex Red	16p
XR45Y	Extra Flex Yellow	16p
XR22Y	EHT Wire	32p
BL11M	Strappg Wire 16swg	82p
BL12N	Strappg Wire 18swg	87p
BL13P	Strappg Wire 20swg	95p■
BL14Q	Strappg Wire 22swg	94p
BL15R	Strappg Wire 24swg	96p
BL16S	EC Wire 14 swg	70p
BL24B	EC Wire 16 swg	79p
BL25C	EC Wire 18 swg	88p
BL26D	EC Wire 20 swg	89p
BL27E	EC Wire 22 swg	93p
BL28F	EC Wire 24 swg	£1.05

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BL29G	EC Wire 26 swg	£1.07
BL39N	EC Wire 28 swg	£1.07
BL40T	EC Wire 30 swg	£1.10
BL41U	EC Wire 32 swg	£1.12
BL42V	EC Wire 34 swg	£1.16
BL43W	EC Wire 36 swg	£1.25
BL44X	EC Wire 38 swg	£1.25
BL60Q	EC Wire 40 swg	£1.50
BL61R	EC Wire 42 swg	£1.49
BL62S	EC Wire 44 swg	£2.20
BL63T	EC Wire 48 swg	£4.95
XR39N	Zip Wire	14p
XR60Q	HD Loudspeaker Cable	36p
YG08J	Litz Speaker Leads	£8.99
XR06G	Ribbn Cable 10-Way	60p
XR07H	Ribbn Cable 20-Way	£1.20
XR65V	IDC Cable 12-Way	£2.11

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XR47B	Twn Mains DS Black	28p
XR00A	Twn Mains DS White	18p
XR61R	Twin 6A Mains Orange	49p
XR62S	Twin 6A Mains White	49p
XR01B	Min Mains Black	35p
XR02C	Min Mains White	36p
XR03D	6A Mains Black	56p
XR04E	6A Mains White	56p
XR05F	6A Mains Orange	70p
XR09K	HD Mains Black	99p
XR10L	HD Mains White	80p
XR11M	HD Mains Orange	90p
XR24B	Cotton Mains	94p
BL71N	Stretchflex 1A	£1.05
BL72P	Stretchflex 6A	£5.95
XR48C	4-Core Mains	£1.05

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XR49D	1.0mm TE Cable	43p
XR50E	1.5mm TE Cable	48p
XR51F	2.5mm TE Cable	65p
XR52G	6mm TE Cable	£1.75
XR53H	1mm Trpl &ECC Cbl	69p
XR15R	Min Screened	15p
XR12N	Cable Single Black	19p
XR13P	Cable Single Grey	19p
XR14Q	Cable Single White	19p
XR16S	Single Mic Cable	42p

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XR18U	Low Noise Scnd	40p
XR19V	Low C Cable	55p
XR63T	UR67 RF Cable	£1.95
XR08J	Twin Mic Cable	82p
XR20W	Lapped Pair	21p
XR21X	Cable Twin	29p
XR23A	Cable Quad	28p
XR25C	Multi-Core 4-Way	60p

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XR26D	Multi-Core 6-Way	65p
XR27E	Multi-Core 9-Way	86p
XR28F	Multi-Core 15-Way	£1.25
XR46A	Multi-Core 25-Way	£1.74
XR54J	Multi-Core 36-Way	£2.31
BH30H	Scr Strtchflx Blck	£1.80
BH31J	Scr Strtchflx Blue	£1.80
BH33L	Scr Stchflx Psychdic	DIS
BH34M	Scr Stretchflex Red	£1.80
HQ49D	Twin Stretchflex	£2.40
XR30H	Standard Co-Ax	48p
XR29G	Low Loss Co-Ax	50p
XR31J	Bal Feeder	19p
YR19V	Marker A0	9p
YR20W	Marker A1	9p
YR21X	Marker A2	9p
YR22Y	Marker A3	9p
YR23A	Marker A4	9p
YR24B	Marker A5	9p
YR25C	Marker A6	9p
YR26D	Marker A7	9p
YR27E	Marker A8	9p
YR28F	Marker A9	9p
YR29G	Marker B0	10p
YR30H	Marker B1	10p
YR31J	Marker B2	9p
YR32K	Marker B3	10p
YR33L	Marker B4	10p
YR34M	Marker B5	10p
YR35Q	Marker B6	10p
YR36P	Marker B7	10p
YR37S	Marker B8	10p
YR38R	Marker B9	10p
YR39N	Marker C0	10p
YR40T	Marker C1	10p
YR41U	Marker C2	10p
YR42V	Marker C3	10p
YR43W	Marker C4	10p
YR44X	Marker C5	10p
YR45Y	Marker C6	10p
YR46A	Marker C7	10p
YR47B	Marker C8	10p
YR48C	Marker C9	10p

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BF86T	Heat Shrink CP 16	55p
BF87U	Heat Shrink CP 24	65p
BF88V	Heat Shrink CP 32	30p
BF89W	Heat Shrink CP 48	32p
BF90X	Heat Shrink CP 64	34p
YR17T	Heat Shrink CP95	50p
YR18U	Heat Shrink CP127	£1.10
BL66W	Ht-Resist Sleeve Blk	12p
BL69A	Ht-Resist Sleeve Grn	12p
BL70M	Ht-Resist Sleeve Red	12p
BH00A	Systoflex 1mm Black	6p
BH01B	Systoflex 1mm Blue	6p
BH02C	Systoflex 1mm Green	6p
BH03D	Systoflex 1mm Red	6p
BH04E	Systoflex 1mm White	6p
BH05F	Systoflex 1mm Yellow	6p
BH06G	Systoflex 2mm Black	9p
BH07H	Systoflex 2mm Blue	9p
BH08J	Systoflex 2mm Green	9p
BH09K	Systoflex 2mm Red	9p
BH10L	Systoflex 2mm White	11p
BH11M	Systoflex 2mm Yellow	9p
BH12N	Systoflex 4mm Black	15p
BH13P	Systoflex 4mm Blue	15p
BH14Q	Systoflex 4mm Green	15p
BH15R	Systoflex 4mm Red	15p
BH16S	Systoflex 4mm White	15p
BH17T	Systoflex 4mm Yellow	15p

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BH42V	Systoflex 6mm Black	17p
BH43W	Systoflex 10mm Black	24p
BL65V	Lacing Cord	98p
BL57M	Spirawrap 1/8in	18p
BL58N	Spirawrap 1/4in	21p
BL59P	Spirawrap 1/2in	46p
BF91Y	Tie-Wrap 92	2p
BF92A	Tie-Wrap 140	3p
BF93B	Tie-Wrap 186	4p
BF94C	Cable Tie Base	19p
BH26D	Safix 4	9p
BH27E	Safix 8	10p
BH28F	Safix 12	13p

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LR44X	Cable P Clip 3/16in	3p
LR45Y	Cable P Clip 1/4in	3p
LR46A	Cable P Clip 5/16in	3p
LR04E	Cable Clip 3/8in	3p
BH18U	Hiatt Rd 2.3/4mm	21p
BH19V	Hiatt Rd 3.1/2mm	24p
BH20W	Hiatt Rd 4mm	24p
BH21X	Hiatt Rd 5mm	24p
BH22Y	Hiatt Rd 6mm	25p
BH23A	Hiatt Rd 7mm	28p
BH24B	Hiatt Rd 8mm	29p
BH36P	Hiatt Rd 9mm	37p
BH25C	Hiatt Flat 4mm	20p
BH37S	Hiatt Flat 5mm	23p
BH38R	Hiatt Flat 7mm	27p
BH39N	Hiatt Flat 9mm	32p
BH40T	Hiatt Flat 10mm	34p
BH41U	Hiatt Flat 14mm	40p

CAPACITORS

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WX35Q	Ceramic 1.8	6p
WX36P	Ceramic 2.2	6p
WX37S	Ceramic 2.7	6p
WX38R	Ceramic 3.3	6p
WX39N	Ceramic 3.9	6p
WX40T	Ceramic 4.7	6p
WX41U	Ceramic 5.6	6p
WX42V	Ceramic 6.8	6p
WX43W	Ceramic 8.2	6p
WX44X	Ceramic 10	6p
WX45Y	Ceramic 12	6p
WX46A	Ceramic 15	6p
WX47B	Ceramic 18	6p
WX48C	Ceramic 22	6p
WX49D	Ceramic 27	6p
WX50E	Ceramic 33	6p
WX51F	Ceramic 39	6p
WX52G	Ceramic 47	6p
WX53H	Ceramic 56	6p
WX54J	Ceramic 68	6p
WX55K	Ceramic 82	6p
WX56L	Ceramic 100	6p
WX57M	Ceramic 120	6p
WX58N	Ceramic 150	6p
WX59P	Ceramic 180	6p
WX60Q	Ceramic 220	6p
WX61R	Ceramic 270	6p
WX62S	Ceramic 330	6p
WX63T	Ceramic 390	6p
WX64U	Ceramic 470	6p
WX65V	Ceramic 560	6p
WX66W	Ceramic 680	6p
WX67X	Ceramic 820	6p
WX68Y	Ceramic 1000	6p
WX69A	Ceramic 1200	6p
WX70M	Ceramic 1500	6p
WX71N	Ceramic 1800	6p
WX72P	Ceramic 2200	6p
WX73Q	Ceramic 2700	6p
WX74R	Ceramic 3300	6p
WX75S	Ceramic 3900	6p
WX76H	Ceramic 4700	6p
WX77J	Ceramic 10,000	6p
WX78K	Ceramic 22,000	6p
YY24B	Monocap 0.001uF	19p
YY25C	Monocap 0.0022uF	20p
YY07H	Monocap 0.0047uF	20p
YY08J	Monocap 0.01uF	21p
YY09K	Monocap 0.022uF	25p
YY10L	Monocap 0.047uF	28p
YY11M	Monocap 0.1uF	36p
YR73Q	Minidisc 0.01uF	5p
YR74R	Minidisc 0.047uF	5p
YR75S	Minidisc 0.1uF	7p
YR76H	Minidisc 0.47uF	15p
BX00A	Disc 0.01uF	10p
BX01B	Disc 0.022uF	10p
BX02C	Disc 0.047uF	12p
BX03D	Disc 0.1uF	12p

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BX05F	HV Disc 10	14p
BX06G	HV Disc 47	19p
BX07H	HV Disc 100	22p
BX10L	HV Disc 470	11p
BX12N	HV Disc 1000	11p
BX13P	HV Disc 2200	11p
BX14Q	HV Disc 4700	22p
BX15R	HV Disc 10,000	19p
HY18U	1000V Disc 4700pF	18p
BX16S	Feed Thro Cap	8p
WX00A	Mica 2.2pF	27p
WX01B	Mica 3.3pF	27p
WX02C	Mica 5pF	27p
WX03D	Mica 10pF	27p
WX04E	Mica 18pF	27p
WX05F	Mica 22pF	27p
WX06G	Mica 27pF	28p
WX07H	Mica 33pF	28p
WX08J	Mica 39pF	28p
WX09K	Mica 47pF	28p
WX10L	Mica 56pF	28p
WX11M	Mica 68pF	28p
WX12N	Mica 82pF	28p
WX13P	Mica 100pF	28p
WX14Q	Mica 120pF	28p
WX15R	Mica 150pF	28p
WX16S	Mica 180pF	28p
WX17T	Mica 220pF	28p
WX18U	Mica 270pF	49p
WX19V	Mica 330pF	49p
WX20W	Mica 390pF	49p
WX21X	Mica 470pF	49p
WX22Y	Mica 560pF	49p
WX23A	Mica 680pF	51p
WX24B	Mica 820pF	51p
WX25C	Mica 1000pF	56p
WX26D	Mica 1500pF	65p
WX27E	Mica 1800pF	72p

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WX28F	Mica 2200pf	69p■
WX29G	Mica 2700pF	92p
WX30H	Mica 3600pF	99p
WX31J	Mica 4700pF	£1.25■
WX32K	Mica 6800pF	DIS
WX33L	Mica 8200pF	£2.09
WX34M	Mica 10,000pF	£1.99■
BX24B	Polystyrene 22	13p
BX25C	Polystyrene 33	8p
BX26D	Polystyrene 47	8p
BX27E	Polystyrene 68	8p
BX28F	Polystyrene 100	8p
BX29G	Polystyrene 150	8p
BX30H	Polystyrene 220	8p
BX31J	Polystyrene 330	8p
BX32K	Polystyrene 470	8p
BX33L	Polystyrene 560	8p
BX34M	Polystyrene 680	8p
BX35Q	Polystyrene 1000	8p
BX36P	Polystyrene 1500	8p
BX37S	Polystyrene 2200	8p
BX38R	Polystyrene 3300	8p
BX39N	Polystyrene 4700	8p
BX40T	Polystyrene 5600	10p
BX41U	Polystyrene 6800	10p
BX92A	Polystyrene 10,000	14p
BX93B	Polystyrene 22,000	19p
BX94C	Polystyrene 47,000	25p
BX95D	Polystyrene 100,000	49p

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1981 Catalogue Page No.		VAT inclusive PRICE
BX46A	1% Polysty 100	27p
BX47B	1% Polysty 150	27p
BX49D	1% Polysty 220	27p
BX50E	1% Polysty 270	29p
BX51F	1% Polysty 330	29p
BX52G	1% Polysty 390	29p
BX53H	1% Polysty 470	29p
BX54J	1% Polysty 560	29p
BX55K	1% Polysty 750	29p
BX56L	1% Polysty 1000	29p
BX57M	1% Polysty 1200	29p
BX58N	1% Polysty 1500	29p
BX59P	1% Polysty 1800	29p
BX60Q	1% Polysty 2200	29p
BX61R	1% Polysty 2700	29p
BX62S	1% Polysty 3300	29p
BX63T	1% Polysty 3900	29p
BX64U	1% Polysty 4700	37p
BX65V	1% Polysty 5600	37p
BX66W	1% Polysty 6800	37p
BX85G	1% Polysty 8200	37p
BX86T	1% Polysty 10,000	37p
BX87U	1% Polysty 22,000	48p
WW22Y	Carbonate 0.001	9p
WW23A	Carbonate 0.0015	9p
WW24B	Carbonate 0.0022	9p
WW25C	Carbonate 0.0033	9p
WW26D	Carbonate 0.0047	9p
WW27E	Carbonate 0.0068	9p
WW28F	Carbonate 0.0082	9p
WW29G	Carbonate 0.01	9p
WW30H	Carbonate 0.012	9p
WW31J	Carbonate 0.015	9p
WW32K	Carbonate 0.018	9p
WW33L	Carbonate 0.022	10p
WW34M	Carbonate 0.027	11p
WW35Q	Carbonate 0.033	11p
WW36P	Carbonate 0.039	11p
WW37S	Carbonate 0.047	11p
WW38R	Carbonate 0.056	14p■
WW39N	Carbonate 0.068	12p
WW40T	Carbonate 0.082	14p
WW41U	Carbonate 0.1	11p
WW42V	Carbonate 0.12	11p
WW43W	Carbonate 0.15	14p
WW44X	Carbonate 0.18	14p
WW45Y	Carbonate 0.22	16p
WW46A	Carbonate 0.27	16p
WW47B	Carbonate 0.33	22p■
WW48C	Carbonate 0.39	22p■
WW49D	Carbonate 0.47	25p
WW50E	Carbonate 0.56	27p
WW51F	Carbonate 0.68	36p
WW52G	Carbonate 0.82	38p
WW53H	Carbonate 1	42p
BX70M	Polyester 0.01uF	8p
BX71N	Polyester 0.015uF	8p
BX72P	Polyester 0.022uF	8p
BX73Q	Polyester 0.033uF	9p
BX74R	Polyester 0.047uF	9p
BX75S	Polyester 0.068uF	9p
BX76H	Polyester 0.1uF	9p
BX77J	Polyester 0.15uF	11p
BX78K	Polyester 0.22uF	13p
BX79L	Polyester 0.33uF	18p
BX80B	Polyester 0.47uF	21p
BX81C	Polyester 0.68uF	29p
BX82D	Polyester 1uF	31p
BX83E	Polyester 1.5uF	56p
BX84F	Polyester 2.2uF	64p

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1981 Catalogue Page No.		VAT inclusive PRICE
WW15R	Mylar 0.001	5p
WW16S	Mylar 0.0022	5p
WW17T	Mylar 0.0047	5p
WW18U	Mylar 0.01	6p
WW19V	Mylar 0.022	6p
WW20W	Mylar 0.047	8p
WW21X	Mylar 0.1	10p
WW83E	Mylar 0.22	16p
FF53H	IS Cap 0.01uF	22p
FF54J	IS Cap 0.022uF	23p
FF55K	IS Cap 0.047uF	23p
FF56L	IS Cap 0.1uF	32p
FF57M	IS Cap 0.22uF	45p
FF58N	IS Cap 0.47uF	78p
BX22Y	Mx D 0.001uF 1500V	25p
BX42V	Mx D 0.0047uF 1000V	DIS
BX43W	Mix D 0.01 1000V	DIS
BX44X	Mix D 0.022uF 1000V	DIS
BX45Y	Mix D 0.047uF 1000V	DIS
BX67X	Mix D 0.1uF 600V	DIS
BX68Y	Mix D 0.1uF 1000V	DIS
BX69A	Mix D 0.22uF 1000V	DIS
BX90X	Mix D 0.47uF 1000V	DIS
BX91Y	Mix D 1.0uF 600V	DIS
WW54J	Tant 0.1uF 35V	13p
WW55K	Tant 0.15uF 35V	13p
WW56L	Tant 0.22uF 35V	16p
WW57M	Tant 0.33uF 35V	18p
WW58N	Tant 0.47uF 35V	17p
WW59P	Tant 0.68uF 35V	17p
WW60Q	Tant 1.0uF 35V	18p
WW61R	Tant 1.5uF 35V	18p
WW62S	Tant 2.2uF 35V	23p
WW63T	Tant 3.3uF 35V	19p
WW64U	Tant 4.7uF 16V	18p■
WW65V	Tant 4.7uF 35V	23p
WW66W	Tant 6.8uF 16V	21p
WW67X	Tant 6.8uF 35V	24p
WW68Y	Tant 10uF 16V	25p
WW69A	Tant 10uF 25V	28p
WW70M	Tant 10uF 35V	36p
WW72P	Tant 22uF 16V	39p
WW73Q	Tant 22uF 25V	65p
WW74R	Tant 33uF 10V	32p
WW75S	Tant 47uF 10V	57p
WW76H	Tant 47uF 16V	75p■
WW78K	Tant 100uF 3V	35p
WW79L	Tant 100uF 10V	£1.25
YY29G	Minelect 0.1uF 50V	13p
YY30H	Minelect 0.47uF 50V	13p
YY31J	Minelect 1uF 50V	14p■
YY32K	Minelect 2.2uF 50V	15p
YY33L	Minelect 4.7uF 25V	21p
YY34M	Minelect 10uF 16V	13p
YY35Q	Minelect 10uF 25V	16p
YY36P	Minelect 22uF 16V	18p
YY37S	Minelect 47uF 16V	22p

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1981 Catalogue Page No.		VAT inclusive PRICE
FF00A	PC Elect 0.47uF 100V	11p
FF01B	PC Elect 1uF 100V	11p
FF02C	PC Elect 2.2uF 63V	10p
FF03D	PC Elect 4.7uF 63V	10p
FF04E	PC Elect 10uF 35V	10p
FF05F	PC Elect 10uF 63V	11p
FF06G	PC Elect 22uF 16V	10p
FF07H	PC Elect 22uF 63V	12p
FF08J	PC Elect 47uF 25V	12p
FF09K	PC Elect 47uF 63V	14p
FF10L	PC Elect 100uF 10V	10p
FF11M	PC Elect 100uF 25V	12p
FF12N	PC Elect 100uF 63V	22p
FF13P	PC Elect 220uF 16V	12p
FF14Q	PC Elect 220uF 63V	33p
FF15R	PC Elect 470uF 16V	20p
FF16S	PC Elect 470uF 25V	25p
FF59P	PC Elect 470uF 63V	56p
FF17T	PC Elect 1000uF 16V	27p
FF18U	PC Elect 1000uF 25V	33p
FF60Q	PC Elect 2200uF 16V	42p
FB11M	Axial 0.47uF 250V	21p
FB12N	Axial 1uF 63V	8p
FB13P	Axial 1uF 450V	25p
FB14Q	Axial 1.5uF 63V	10p
FB15R	Axial 2.2uF 63V	10p
FB16S	Axial 2.2uF 450V	30p
FB17T	Axial 3.3uF 63V	10p
FB18U	Axial 4.7uF 63V	12p
FB19V	Axial 4.7uF 450V	33p
FB20W	Axial 6.8uF 40V	15p
FB21X	Axial 6.8uF 63V	16p
FB22Y	Axial 10uF 25V	9p
FB23A	Axial 10uF 63V	11p
FB24B	Axial 10uF 100V	18p
FB25C	Axial 10uF 450V	45p
FB26D	Axial 15uF 16V	9p
FB27E	Axial 15uF 40V	11p
FB28F	Axial 15uF 63V	16p
FB29G	Axial 22uF 10V	10p
FB30H	Axial 22uF 25V	11p
FB31J	Axial 22uF 63V	16p
FB32K	Axial 22uF 100V	24p
FB33L	Axial 22uF 450V	55p
FB34M	Axial 33uF 6.3V	10p
FB35Q	Axial 33uF 16V	11p
FB36P	Axial 33uF 40V	12p
FB37S	Axial 47uF 4V	14p
FB38R	Axial 47uF 10V	10p
FB39N	Axial 47uF 25V	13p
FB40T	Axial 47uF 40V	14p
FB41U	Axial 47uF 63V	17p
FB42V	Axial 47uF 100V	32p
FB43W	Axial 47uF 450V	85p
FB44X	Axial 68uF 6.3V	15p
FB45Y	Axial 68uF 16V	16p
FB47B	Axial 100uF 6.3V	DIS
FB48C	Axial 100uF 10V	11p
FB49D	Axial 100uF 25V	14p
FB50E	Axial 100uF 40V	18p
FB51F	Axial 100uF 63V	22p
FB52G	Axial 100uF 100V	52p
FB53H	Axial 100uF 250V	85p
FB54J	Axial 150uF 6.3V	21p
FB55K	Axial 150uF 16V	13p
FB56L	Axial 150uF 25V	15p
FB58N	Axial 150uF 63V	32p
FB59P	Axial 220uF 6.3V	DIS
FB60Q	Axial 220uF 10V	12p
FB61R	Axial 220uF 16V	14p
FB62S	Axial 220uF 25V	18p
FB63T	Axial 220uF 40V	27p
FB64U	Axial 220uF 63V	32p
FB65V	Axial 220uF 100V	55p
FB66W	Axial 330uF 6.3V	DIS
FB67X	Axial 330uF 10V	14p
FB68Y	Axial 330uF 25V	20p
FB69A	Axial 330uF 63V	44p
FB70M	Axial 470uF 6.3V	15p
FB71N	Axial 470uF 10V	22p
FB72P	Axial 470uF 16V	26p
FB73Q	Axial 470uF 25V	30p
FB74R	Axial 470uF 63V	55p
FB75S	Axial 470uF 100V	89p
FB77J	Axial 680uF 16V	30p
FB78K	Axial 680uF 25V	38p
FB79L	Axial 680uF 40V	68p
FB80B	Axial 1000uF 6.3V	29p
FB81C	Axial 1000uF 10V	25p
FB82D	Axial 1000uF 16V	32p
FB83E	Axial 1000uF 25V	40p
FB84F	Axial 1000uF 63V	£1.00
FB85G	Axial 1500uF 6.3V	32p
FB86T	Axial 1500uF 10V	38p
FB87U	Axial 1500uF 16V	42p
FB89W	Axial 2200uF 10V	40p
FB90X	Axial 2200uF 25V	57p
FB91Y	Axial 2200uF 40V	98p
FB92A	Axial 2200uF 63V	£1.54
FB93B	Axial 3300uF 6.3V	58p
FB94C	Axial 3300uF 25V	94p
FB95D	Axial 4700uF 10V	60p
FB96E	Axial 4700uF 25V	£1.25

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1981 Catalogue Page No.		VAT inclusive PRICE
FB97F	Reversolytic 1uF	29p
FB00A	Reversolytic 1.5uF	32p
FB01B	Reversolytic 2.2uF	36p
FB02C	Reversolytic 3.3uF	42p
FB03D	Reversolytic 4.7uF	46p
FB04E	Reversolytic 6.8uF	54p
FB06G	Reversolytic 10uF	58p
FB07H	Reversolytic 15uF	66p
FB08J	Reversolytic 22uF	68p
FB09K	Reversolytic 33uF	70p
FF19V	Can 1000uF 100V	£1.86
FF20W	Can 1500uf 63V	£1.95
FF21X	Can 2200uF 40V	£1.86
FF22Y	Can 2200uF 63V	£3.25
FF24B	Can 3300uF 40V	£2.15
FF25C	Can 3300uF 63V	£3.55
FF26D	Can 4700uF 25V	£1.45
FF27E	Can 4700uF 40V	£4.35
FF28F	Can 4700uF 63V	£3.85
FF29G	Can 4700uF 100V	£5.35
FF30H	Can 6800uf 40V	£4.55
FF31J	Can 10,000uF 25V	£4.95
FF32K	Can 10,000uF 63V	£5.45
FF33L	Clip Can 25	15p
FF34M	Clip Can 35	19p
FF35Q	Clip Can 40	19p
FF36P	Clip Can 50	45p
FF37S	Horiz Clip 25	18p
FF38R	Horiz Clip 35	18p
WL68Y	Trimmer 5.5pF	30p
WL69A	Trimmer 10pF	30p
WL70M	Trimmer 22pF	26p
WL72P	Trimmer 65pF	29p
WL71N	Trimmer 40pF	19p
WL73Q	Trimmer 500pF	33p
YQ24B	AM Varitune	£1.32

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1981 Catalogue Page No.		VAT inclusive PRICE
FF39N	Vari O	£4.45
FF40T	DG Vari	£6.95
FF41U	Twin OO	£5.60
FF42V	SW Trim 10pF	£4.45
FF43W	SW Trim 15pF	£4.45
FF44X	SW Trim 25pF	£4.80
FF45Y	SW Trim 50pF	£4.45
FF46A	SW Trim 60pF	£5.35
FF47B	SW Trim 75pF	£4.45
FF48C	SW Trim 100pF	£5.35
FF49D	SW Trim 150pF	£5.50
FF50E	Dilecon 300pF	£4.45
FF51F	Dilecon 500pF	£4.35
FY77J	FS Crystal 100kHz	£4.55
HX62S	FS Crystal 1MHz	£5.95
FY78K	FS Crystal 10MHz	£2.95
FY79L	MP Crystal 1MHz	£4.45
FY80B	MP Crystal 2MHz	£2.20■
FY81C	MP Crystal 2.4576MHz	£3.35
FY82D	MP Crystal 4MHz	£1.80
FY83E	MP Crystal 6.144MHz	£1.25■
FY84F	MP Crystal 18.432MHz	£2.65
HX30H	MCR Crys Brown Pairs	£2.96
HX31J	MCR Crystal Red Pair	£2.96
HX32K	MCR Crys Orange Pair	£2.96
HX33L	MCR Crys Yellow Pair	£2.96
HX34M	MCR Crystal Green Pr	£2.96
HX35Q	MCR Crys Blue Pair	£2.96
FY85G	Colour TV Crystal	£1.20

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1981 Catalogue Page No.		VAT inclusive PRICE
FY86T	Crystal 50HzX 2.16	£3.15
FY87U	Crystal 1HzX 2.22	£3.15
HX60Q	Crystal Socket 25u	23p
HX61R	Crystal Socket 6u	45p
HX99H	Ceramic Fltr 10.7MHz	60p

CAR EQUIPMENT

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1981 Catalogue Page No.		VAT inclusive PRICE
HW18U	Car Aerial Pull Up	£1.99
YB67X	Car Aerial Roof Top	£5.75
LH99H	Windscreen Aerial	£2.69
XX37S	Car Aerial Booster	£6.95
RW29G	Plugpak R	£1.95
RW30H	Plugpak S	£2.35
HW11M	Cigar Lighter	£2.65
YX75S	Accessory Socket	£1.55
HW12N	Car Accessory Plug	45p
YB68Y	Car Lighter Ext Lead	£2.25
YW59P	Car Power Lead	£2.70
FQ73Q	Map Light	69p

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1981 Catalogue Page No.		VAT inclusive PRICE
HW22Y	12V Inspection Lamp	£1.60
FQ76H	Inspection Lamp L86	£2.60
WY10L	Front Fog Lamp	£11.55
LY07H	Fog Lamp	£5.65
LQ13P	Wiper Kit	£21.75
LY08J	Reversing Lamp	£4.55
LQ14Q	Washer Kit	£11.95
WY09K	Demister	£6.95■
HQ30H	Wiper Control	£9.65
FQ78K	Car Ammeter	£2.95■

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1981 Catalogue Page No.		VAT inclusive PRICE
HQ35Q	Charger Ammeter	£1.47
HW16S	Car Flash 4-Lamp	£1.63
HW17T	Car Flash 6-Lamp	£1.55
FQ79L	Caravan Flasher	£7.45
FQ92A	7-Pin Trailer Plug	£2.35
FQ93B	7-Pin Trailer Socket	£2.98
XR55K	7-Core Trailer Cable	£1.15
FQ94C	Trailer Socket Bolts	33p
YB70M	Trailer Lamp Cluster	£4.97
YB71N	Trailer Reflector	£1.45
FQ95D	Sign 50mph	29p
FQ96E	Sign GB	29p
FQ88V	Plug-Top Supp Strt	42p
FQ89W	Plug-Top Supp Ang	50p
FQ90X	In-Line Plug Supp	25p

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1981 Catalogue Page No.		VAT inclusive PRICE
HW01B	Supp Cap Small Lucar	59p
*HW02C	Supp Cap Large Lucar	69p
HW03D	Supp Cap Spade	59p
FQ87U	Supp Cap 3uF	£1.12
FQ91Y	Suppressor Choke	84p
FQ77J	Jumper Leads	£4.40
YL02C	Magnilamp	95p
FQ97F	Anti-Glare Strip	85p■
FQ98G	Luggage Elastic	45p
FQ99H	Ice Scraper	28p
YB72P	Tow Rope	£4.25
FY00A	Keep Clean Kit	DIS
YB94C	Plug Spanner	DIS
FY01B	Tyre Pressure Gauge	£1.55
*XY74R	Electric Pump	£18.79

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1981 Catalogue Page No.		VAT inclusive PRICE
XB44X	Car Speakers Shelf	£6.75
XB42V	Car Speakers Door	£6.45
XY73Q	10W Shelf Spkrs	£18.25
XQ75S	10W Car Stereo Spkrs	£13.95■
XQ76H	20W Air Suspen Spkrs	£19.49
LY06G	Car Cassette Carrier	£4.85
AF00A	Booster Amp	£17.99■
AF01B	Booster Equaliser	£37.50

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1981 Catalogue Page No.		VAT inclusive PRICE
YX86T	Flow Sensor	£16.90
YX85G	Speed Sensor	£11.93

CONNECTORS

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1981 Catalogue Page No.		VAT inclusive PRICE
HF25C	Croc Clips	10p■
HF23A	Alligator Clip Black	13p
HF24B	Alligator Clip Red	11p
HF26D	Charger Clip	25p
BW69A	Croc Lead Kit	£1.45
HF10L	Push-On Receptacle	33p
HF11M	Push-On Blade	33p
HF12N	Push-On Covers	73p
YX47B	Comcon Block 5-way	36p
YX48C	Comcon Terminal	5p
HF02C	Terminal Post Black	35p
HF03D	Terminal Post Blue	37p
HF04E	Terminal Post Brown	37p
HF05F	Terminal Post Green	38p
HF06G	Terminal Post Grey	38p
HF07H	Terminal Post Red	35p
HF08J	Terminal Post White	38p
HF09K	Terminal Post Yellow	38p
HF13P	Press Terminal Black	28p
HF14Q	Press Terminal Blue	28p
HF15R	Press Terminal Green	28p
HF16S	Press Terminal Red	28p
HF17T	Press Terminal White	30p
HF18U	Press Terminal Yellw	28p
BW72P	Quickterm Lever 2way	49p
YR92A	Quickterm Type B	62p
BW71N	Quckterm Push 4 way	62p

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1981 Catalogue Page No.		VAT inclusive PRICE
WL57M	1mm Plug Black	20p
WL58N	1mm Plug Red	20p
WL59P	1mm Socket Black	15p
WL60Q	1mm Socket Red	15p
HF38R	2mm Plug Black	17p
HF39N	2mm Plug Blue	18p
HF40T	2mm Plug Green	17p
HF41U	2mm Plug Red	17p
HF42V	2mm Plug White	17p
HF43W	2mm Plug Yellow	18p
HF44X	2mm Socket Black	15p
HF45Y	2mm Socket Blue	15p
HF46A	2mm Socket Green	15p
HF47B	2mm Socket Red	15p
HF48C	2mm Socket White	15p
HF49D	2mm Socket Yellow	15p
HF50E	Wander Plug Black	17p
HF51F	Wander Plug Blue	17p
HF52G	Wander Plug Green	17p
HF53H	Wander Plug Red	17p
HF54J	Wander Plug White	17p
HF55K	Wander Plug Yellow	14p
HF56L	Wander Socket Black	14p
HF57M	Wander Socket Blue	14p
HF58N	Wander Socket Green	14p
HF59P	Wander Socket Red	14p
HF60Q	Wander Socket White	14p
HF61R	Wander Socket Yellow	14p
HF62S	4mm Plug Black	15p
HF63T	4mm Plug Blue	15p
HF64U	4mm Plug Brown	15p
HF65V	4mm Plug Green	15p
HF66W	4mm Plug Red	15p
HF67X	4mm Plug White	15p
HF68Y	4mm Plug Yellow	15p
HF69A	4mm Socket Black	15p
HF70M	4mm Socket Blue	15p
HF71N	4mm Socket Brown	15p
HF72P	4mm Socket Green	15p
HF73Q	4mm Socket Red	15p
HF74R	4mm Socket White	17p
HF75S	4mm Socket Yellow	19p
HF34M	4mm Patch Cord	£1.98
HQ54J	Screw-Cap Phono Blk	12p
HQ55K	Screw Cap Phono Blue	12p
HQ58N	Screw Cap Phono Red	12p
HQ59P	Screw Cap Phono Whte	12p
HQ60Q	Screw Cap Phono Yell	12p
HH01B	[illegible] Phono	17p
YW06G	Threaded Phono Skt	15p
HH02C	Phono Socket Single	12p
HH03D	Phono Socket Twin	16p
BW74R	Phono Socket Quad	35p
BW75S	Phono Socket 5-way	45p
BW76H	Phono Socket 6-way	55p

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1981 Catalogue Page No.		VAT inclusive PRICE
HH04E	Line Phono	20p
HH05F	Phono Conn	19p
HF76H	2.5 Plug Plas	13p
HF77J	2.5 Plug Scr	22p
HF78K	2.5 Jack Socket	12p
HF79L	2.5 Line Socket	30p
HF80B	Plug Plas 3.5	12p
HF81C	Plug Scr 3.5	22p
HF82D	Jack Socket 3.5	14p
HF83E	Line Socket Plas 3.5	15p
HF84F	Line Socket Scr 3.5	21p
HF85G	Jack Plug Plas	21p
HF86T	Side Jack Plas	25p
HF87U	Jack Plug Scr	39p
YW07H	SR Jack Plug	43p
YL03D	Side Jack Screened	29p
HF88V	Jack Pl Sto Plas	29p
HF89W	Jack Pl Sto Scr	45p
HF90X	Jack Skt Brk	21p
BW78K	Chro Mono Jack Skt	39p
HF91Y	Jack Skt Open	19p
HF92A	Jack Skt Sto	24p

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1981 Catalogue Page No.		VAT inclusive PRICE
BW79L	Chro Stereo Jack Skt	35p
HF93B	Stereo Open Skt	35p
BW80B	DPDT Jack Socket	52p
HH19V	Line Jack Plas	24p
HH20W	Scr Line Jack	42p
HH21X	Stereo Line Skt	30p
HH22Y	Scr Stereo Line Skt	58p
HH07H	Co-ax Plug Aly	24p
HH06G	Co-ax Plug Plas	15p
YW08J	Co-ax Plug Imp	15p
HH08J	Co-ax Socket Pan	29p■
HH09K	Co-ax Socket Flush	25p■
YW09K	Co-ax Line Skt	43p
HH11M	Co-ax Conn	15p
HH13P	Skeleton Car Plug	14p
HH12N	Car Plug Plas	49p
HH14Q	Chassis Car Socket	24p
HH15R	Car Line Socket	DIS
HH16S	FM Aerial Plug	17p
HH17T	BNC Plug	98p
HH18U	BNC Socket	98p

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1981 Catalogue Page No.		VAT inclusive PRICE
YW00A	BNC Square Socket	85p
YW01B	BNC Line Socket	£1.10
YW02C	BNC Straight Adaptor	£1.37
YW03D	BNC T Adaptor	£2.95
BW81C	Plug PL259	51p
BW82D	UHF Reducer Small	17p
BW83E	UHF Reducer Large	17p
BW84F	UHF Socket Round	49p
BW85G	Socket SO239	53p
BW86T	UHF Elbow Adaptor	£1.32
BW87U	UHF Straight Adaptor	59p
BW88V	UHF T Adaptor	£1.55
YW04E	Adaptor 239	£1.12
YW05F	Adaptor 259	£1.40
YX51F	Audio Conn 2-way	£1.15
YX52G	Audio Conn 3-way	£1.35
YX53H	Audio Conn 4-way	£1.26
YX54J	Audio Conn 5-way	£1.55
YX55K	Audio Conn 6-way	£1.75
BW89W	XLR Line Plug	£1.82

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1981 Catalogue Page No.		VAT inclusive PRICE
BW90X	XLR Chassis Socket	£2.95
BW91Y	XLR Line Socket	£2.35
BW92A	XLR Chassis Plug	£1.45
BW94C	Dinlatch 5-pin A Plg	£1.30
BW98G	Dinltch Sckt 5-pin A	69p
HH24B	DIN L/S Plug	10p
HH25C	DIN Plug 3-pin	16p
HH26D	DIN Plug 4-pin	30p
HH27E	DIN Plug 5-pin A	14p■
HH28F	DIN Plug 5-pin B	19p
HH29G	DIN Plug 6-pin	39p
HH30H	DIN Plug 7-pin	19p
HH31J	DIN L/S Socket	7p
HH32K	DIN Socket 3-pin	16p
HH33L	DIN Socket 4-pin	16p
HH34M	DIN Socket 5-pin A	14p
HH35Q	DIN Socket 5-pin B	18p
HH36P	DIN Socket 6-pin	21p
HH37S	DIN Socket 7-pin	19p
HH40T	DIN Line Skt 2-pin	15p
HH41U	DIN Line Scket 3-pin	16p
HH42V	DIN Line Scket 4-pin	DIS
HH43W	DIN Line Skt 5-pin A	16p
HH44X	DIN Line Skt 5-pin B	21p
HH45Y	DIN Line Scket 6-pin	20p
HH46A	DIN Line Scket 7-pin	DIS
YX90X	PC DIN Skt 2-pin	25p
YX91Y	PC DIN Skt 5-pin A	25p

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1981 Catalogue Page No.		VAT inclusive PRICE
YQ48C	D-Range 25-Way Plug	£2.15
YQ49D	D-Range 25W Socket	£2.35
YQ50E	D-Range 25-Way Cover	£2.25
YQ51F	D-Range Latch	33p
WQ14Q	PCB Connectors 45	7p
WQ15R	PCB Connectors Vert	7p
WQ16S	PCB Connectors Horz	7p
FL83E	Edge Connector 108	52p
FL84F	Edge Connector 116	£1.08
FL85G	Edge Connector 124	£1.29
FL86T	Edge Connector 132	£1.95
FL87U	Edge Connector 140	£1.86
FL91Y	Edge Connector FeetG	15p
FL92A	Edge Connector FeetH	14p
FL93B	Edge Connector FeetL	DIS
FL30H	Edge Connector Silvr	£1.99
YR57M	Card Frame Edge Conn	£3.95
YR58N	Edge Conn End Bkt	23p

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1981 Catalogue Page No.		VAT inclusive PRICE
HL01B	Octal Ch Plug	75p
HL00A	Octal Ch Skt	50p
HL02C	8-way Plug	85p
HL03D	8-way Socket	90p
HF35Q	Voltage Selector Skt	DIS
†HF37S	Voltage Selector Plg	95p
YX33L	Multicon Plug 2-way	15p
YX34M	Multicon Plug 4-way	20p
YX35Q	Multicon Plug 9-way	29p
YX36P	Multicon Plug 15-way	43p
YX37S	Multicon Plug 24-way	58p
YX38R	Multicon Plug 36-way	78p
YX39N	Multicon Skt 2-way	18p
YX40T	Multicon Skt 4-way	19p
YX41U	Multicon Skt 9-way	27p
YX42V	Multicon Skt 15-way	45p
YX43W	Multicon Skt 24-way	59p
YX44X	Multicon Skt 36-way	68p
YX45Y	Multicon Plug Pin	3p
YX46A	Multicon Skt Pin	3p

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1981 Catalogue Page No.		VAT inclusive PRICE
YW10L	Minicon Plug 3-pin	20p
YW11M	Minicon Plug 4-pin	22p
YW12N	Minicon Plug 6-pin	29p
YW13P	Minicon Plug 8-pin	39p
YW14Q	Minicon Plug 12-pin	48p
YW15R	RA Minicon Pl 3-pin	31p
YW16S	RA Minicon Pl 4-pin	38p
YW17T	RA Minicon Pl 6-pin	47p
YW18U	RA Minicon Pl 8-pin	52p
YW19V	RA Minicon Pl 12-pin	74p
YW20W	Minicon Hsg 3-pin	10p
YW21X	Minicon Hsg 4-pin	10p
YW22Y	Minicon Hsg 6-pin	12p
YW23A	Minicon Hsg 8-pin	15p
YW24B	Minicon Hsg 12-pin	17p
YW25C	Minicon Terminal	3p
YW26D	Minicon Skt 3-way	24p
YW27E	Minicon Skt 4-way	30p
YW28F	Minicon Skt 6-way	36p
YW29G	Minicon Skt 8-way	50p
YW30H	Minicon Skt 12-way	59p
YW31J	Polarcon 0.1in	6p

1981 Catalogue Page No.		VAT inclusive PRICE
YW95D	IDC Con 3-way	20p
YW96E	IDC Con 4-way	26p
YW97F	IDC Con 6-way	38p
YW98G	IDC Con 8-way	50p
YW99H	IDC Con 12-way	88p
YX49D	IDC Insertion Tool	£1.98
HL04E	Wafercon Plug 3-pin	12p
HL05F	Wafercon Plug 4-pin	14p
HL06G	Wafercon Plug 6-pin	19p
HL07H	Wafercon Plug 8-pin	19p
HL08J	Wafercon Plug 12-pin	29p

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HL09K	Wafercon Skt 3-way	11p
HL10L	Wafercon Skt 4-way	10p
HL11M	Wafercon Skt 6-way	16p
HL12N	Wafercon Skt 8-way	17p
HL13P	Wafercon Skt 12-way	25p
HL14Q	Wafercon Terminal	3p
YW32K	Polarcon 0.2in	6p
YW40T	Compactboard	£13.50
YY22Y	CB Pin Blue	37p
YY23A	CB Pin Red	37p
YY26D	CT Pin White	£1.26
YY27E	AT Pin Black	£1.33
YR63T	CB Plug Extractor	£7.50
YB08J	Large Patchboard	£111.00
WQ10L	Large Patch Plug	37p
HH39N	Multi-position Plug	67p
HH38R	Universal Plug	85p

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HH60Q	Std Power Plug 2.1	14p
HH61R	Long Pwr Plug 2.1	16p
HH62S	Std Power Plug 2.5	15p
HH63T	Long Pwr Plug 2.5	15p
HH85G	Power Skt 2.1	20p
HH86T	Power Skt 2.5	22p
HH87U	Cassette Skt Nivico	39p
HH88V	Cassette Skt Paros	46p
HL17T	USA Mains Plug	20p
HL18U	Flat Pin M/S	27p
HL19V	Flat Pin Conn	31p
RW56L	Cas Lead Crown	60p
RW57M	Cas Lead Hitachi	60p
RW58N	Cas Lead Nat Pan	60p
RW59P	Cas Lead Nivico	60p
RW60Q	Cas Lead Otake-Orion	60p
RW61R	Cas Lead Paros	65p
RW62S	Cas Lead Philips	75p
RW63T	Cas Lead Sanyo	60p
RW64U	Cas Lead Sharp	60p

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RW65V	Cas Lead Sony	60p
RW66W	Cas Lead Telefunken	65p
YX62S	Cassette Lead OS219	60p
YX63T	Cassette Lead 955	60p
HL16S	Eurosocket	69p■
HL15R	Europlug	48p
HL42V	Euro Facility Outlet	£1.55
HL43W	Euro Facility Plug	75p
BW99H	Euroconn Lead	£1.75
WY16S	Euroboard 4-way	£7.35
WY17T	Euroboard 6-way	£10.75
HL20W	Mains Plug P429	64p
HL44X	Mains Socket P646	£1.39
HL23A	Mains Socket P430SE	£1.15
HL45Y	Mains Plug P649	£1.15
HL46A	Mains Socket P650	98p
HL47B	Mains Plug SA2403	£1.36
HL48C	Mains Socket SA2404	79p
HL27E	Mains Plug SA2190	49p

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HL28F	Mains Socket SA1862	52p
HL49D	Mains Socket SA2111	£1.75
HL30H	Mains Plug SA2019A	£1.48
HL31J	Mains Socket SA2020	£1.34
HL33L	Mains Plug SA2367	£1.55
HL34M	Mains Socket SA2368	93p
HL36P	Mains Plug P635	£1.05
HL37S	Mains Socket P636	£1.29
HL39N	Mains Plug P551	£2.97
HL40T	Mains Socket P552	98p
HL50E	Sleeve 8037	12p
HL51F	Boot 9455	27p
HL52G	Boot 8878	38p

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RW04E	Adaptor E	45p
RW01B	Adaptor B	45p
YW38R	Adaptor W	59p
YW39N	Adaptor X	56p
RW07H	Adaptor H	38p
RW03D	Adaptor D	40p
RW11M	Adaptor M	39p
RW06G	Adaptor G	46p
RW08J	Adaptor J	37p
RW00A	Adaptor A	42p
YW34M	Adaptor S	55p
YW35Q	Adaptor T	£1.25
RW05F	Adaptor F	40p
RW09K	Adaptor K	40p
RW02C	Adaptor C	45p
YW37S	Adaptor V	£1.55
RW12N	Adaptor N	45p
YW33L	Adaptor R	£1.28
HL53H	Adaptor P	£1.30
YW36P	Adaptor U	99p
RW27E	Dinpak P	60p
RW26D	Dinpak N	£1.20
RW45Y	Dinpak 273	£1.45
RW44X	Dinpak 262	75p
RW47B	Dinpak 275	95p
RW25C	Dinpak M	£1.55
RW46A	Dinpak 274	£1.50
RW15R	Dinpak B	£1.55
RW14Q	Dinpak A	£1.10
RW43W	Dinpak 254	£1.10
RW16S	Dinpak C	£1.10
RW22Y	Dinpak J	69p

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RW23A	Dinpak K	65p
RW24B	Dinpak L	87p
RW18U	Dinpak E	82p
RW19V	Dinpak F	95p
RW17T	Dinpak D	£1.42
RW20W	Dinpak G	£1.34
RW49D	Dinpak 280	£1.55

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RW37S	Dinpak 205	DIS
RW48C	Plugpak 279	89p■
RW50E	Plugpak 282	89p
RW51F	Plugpak 283	£1.85
RW28F	Plugpak Q	65p
RW31J	Plugpak T	£2.25
RW32K	Plugpak V	DIS
RW34M	Plugpak X	£2.48
RW35Q	Plugpak HD Guitar	£4.45

CONSUMER

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AF18U	Canon LC31	£6.95
AF19V	Canon LC52	£11.85
AF20W	Canon FC42	£13.95

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AF21X	Canon LC61T	£16.95
AF22Y	Canon P7-D	DIS
YX88V	P7 Paper Roll	46p
YX89W	P7 Ink Cassette	£2.75

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AF02C	Atari 800 Computer	£599.00

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AF03D	Atari 400 8K Computr	DIS
AF28F	Recorder 410	£50.00
AF04E	Printer 822	£265.00

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AF06G	Disc Drive 810	£345.00
YX87U	Mini Floppy Disc	£2.75
AF29G	Interface 850	£135.00
AF07H	8K Memory Module	NYA
AF08J	16K Memory Module	£65.00
AF05F	Printer 825	£550.00
AF30H	Modem 830	NYA
AC38R	See YG48C	See
AC39N	See YG63T	note
AC40T	See YG66W	below

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WF20W	Mag Headset	£4.85
LH81C	Education Headphone	£5.75
LH82D	Boom Mic Headphone	£12.35
LH83E	Stereophone OH150P	£4.25
WF13P	Stereophone HP110C	£5.40
WF14Q	Stereophone DH207	£7.99
LH84F	Stereophone M110B	£8.60
LH85G	Stereophone HS310	£12.50

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WF19V	Sterephone Elec 100	DIS
LB13P	Headphone Adaptor	£3.95
LB72P	Intercom 2-Station	£8.75
XY78K	FM Intercom Pair	DIS
XY77J	4-Channel FM Intrcom	£29.95

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WY11M	Compact PA Amp	£21.50
WY12N	10W PA Amp	£29.95
XY81C	40W PA Amp	£65.50
XY82D	60W PA Amp	£106.75

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AF09K	AM Radio	£1.95
AF10L	AM/FM Radio	£4.95
AF11M	AM/FM/Air Radio	DIS
AF17T	5-Band Radio	£37.50
AF12N	Teak Clock Radio	£22.50
AF13P	Silver Clock Radio	£22.50

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AF14Q	Cassette Clock Radio	£45.90
AF15R	3-Band Radio Recordr	£35.60
AF16S	4-Band Recorder	£44.50
AF27E	GE1305 Equaliser	£77.50

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AC00A	Vid Gme Cnsl	£99.95
AC01B	Air Sea Battle Game	£18.95
AC02C	Space War Game	£14.95■

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AC03D	Outlaw Game	£14.95■
AC04E	Video Olympics Game	£18.95
AC05F	Breakout Game	£18.95
AC06G	Basketball Game	£14.95■
AC07H	Surround Game	£14.95■

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AC09K	Fun Wth Numbers Game	£14.95■
AC10L	Codebreaker Game	£18.95
AC11M	Hunt & Score Game	£18.95
AC12N	Miniature Golf Game	£14.95■
AC13P	Skydiver Game	£14.95■
AC14Q	Street Racer Game	£18.95
AC15R	Bowling Game	£18.95

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AC16S	Brain Games	£24.95
AC18U	Golf Game	£18.95
AC19V	Slot Racers Game	£14.95■
AC21X	Superman Game	£24.95■
AC22Y	Adventure Game	£18.95■
AC24B	Indy 500 Game	£29.95■
AC25C	Backgammon Game	£18.95■

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AC26D	Space Invaders Game	£24.95■
AC27E	Programming Cartrdg	£18.95■
AC28F	Chess Game	£18.95■

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AC20W	Circus Game	£24.95
AC17T	Human Cannonball	£14.95■
AC23A	Casino Game	£18.95■
AC31J	Night Driver Game	£24.95
AC32K	Dodge Em	£18.95
AC33L	Pele Soccer Game	£24.95■

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AC34M	Hangman Game	£14.95■
AC35Q	Video Checkers	£18.95
AC36P	Maze Craze	£24.95
AC29G	Video Game Keyboard	£13.95
AC30H	Video Game Paddles	£13.95
AC37S	Video Game Joysticks	£13.95

ELECTRICAL

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HF01B	Terminal Block 5A	33p
HL54J	Terminal Block 15A	69p
HL55K	Terminal Block 30A	£1.10
HL56L	Terminal Block Conn	£1.47
*HL57M	5 Amp Plug	59p
RW67X	13 Amp Plug Nylon	79p
HL58N	Rubber 13A Plug	99p
HL59P	15A Plug Nylon	99p
HL60Q	Kettle Connector	£1.67
HL61R	Flex Connector	£1.40
HL62S	Mains Adaptor 2-way	£2.20
HL63T	Mains Adaptor 3-way	£2.95
HL64U	Shaver Adaptor	£1.15

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HL65V	Junction Box Small	£1.50
HL66W	Junction Box Lge	99p
HL67X	Junction Box RM	£1.75
HL68Y	Single Skt Unswtched	£1.85
HL69A	Dble Skt Unswitched	£3.75
HL70M	Dble Skt Unswchd Slv	£7.30
HL71N	Single Sw Socket	£2.60
HL72P	Double Sw Socket	£5.20
HL73Q	Trailing Skt Single	£1.75
HL74R	Trailing Dble Skt	£3.45
RW68Y	Dis Board 4-way	£8.75
HL76H	Cooker Switch	£7.30
HL77J	Neon Cooker Switch	DIS
HL78K	Shaver Skt Isolated	£18.75

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HL79L	Shaver Socket	67p
HL80B	Cooker Outlet C	£2.10
HL81C	Cooker Outlet T	£3.20
HL82D	Flex Outlet Unswchd	£3.75
HL83E	Switched Flex Outlet	£4.25
HL84F	Clock Connector S	DIS
HL85G	Clock Connector B	DIS
HL86T	Blanking Plate	85p
HL87U	20A Plateswitch	£3.20
HL88V	20A Water Htr Switch	£4.85
HL89W	Light Swch ST Single	£1.08
HL90X	Light Swch DT Single	£1.49
HL91Y	Light Swch Dual	£2.39
HL92A	Light Switch Triple	£3.25
HL93B	Light Switch Quad	DIS

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FQ10L	250W Rotary Dimmer	£7.3C
FQ12N	250W Push Dmr Sngl	£9.95
FQ13P	250W Push Dmr Dble	£19.49
*FQ14Q	250W Touch Dimmer	£15.95
XX35Q	Remote Control Dmmr	£29.45
XX36P	Dmmr Control Box	£15.75
FQ15R	Security Dimmer	£16.95
FQ16S	Auto Security Switch	£13.25
YB09K	Fl Pattress 16mm Sgl	85p
YB10L	Fl Pattress 25mm Sgl	70p
YB11M	Fl Pattress 25mm Dbl	£1.06
YB12N	Fl Pattress 35mm Dbl	£1.25
YB13P	Steel Pattress 47mm	£2.55
YB14Q	Sur Patt 20mm Sngl	78p
YB15R	Sur Patt 29mm Sngl	92p
YB16S	Sur Patt 29mm Dble	£1.65
YB17T	Sur Patt 47mm Dble	£2.75
YB18U	Conversion Pattress	£2.50

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FQ00A	Ceiling Switch 1-way	£2.65
FQ01B	Ceiling Switch 2-way	DIS
FQ02C	Lampholder 702	75p
FQ03D	Lampholder 254 CG	DIS
FQ04E	Lampholder 252 1/2in	65p
LB63T	Bayonet L/Hldr	88p
FQ05F	Ceiling Rose	£1.08
FQ06G	BC Adaptor	DIS
FQ07H	Starter 80W	25p
YB19V	Time Switch	£16.95
RW69A	Power Controller	£20.95
YB20W	Room Thermostat	£8.25
XY08J	Extn Lead 5A	£13.80
XY09K	Extn Lead 13A	£17.95

HARDWARE

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BF00A	Bolt 2BA 1/2in	33p
BF01B	Bolt 2BA 1in	85p
BF02C	Bolt 4BA 1/4in	25p
BF03D	Bolt 4BA 1/2in	28p
BF04E	Bolt 4BA 1in	30p
LR52G	Bolt 4BA 1.1/2in	33p
BF05F	Bolt 6BA 1/4in	12p
BF06G	Bolt 6BA 1/2in	14p
BF07H	Bolt 6BA 1in	43p
LR53H	Bolt 6BA 1.1/2in	63p
BF08J	Bolt 8BA 1/4in	28p
BF09K	Bolt 8BA 1/2in	24p
LR54J	C/S Screw 2BA 1/2in	14p
LR55K	C/S Screw 4BA 1/4in	14p
BF10L	C/S Screw 4BA 1/2in	17p
BF11M	C/S Screw 4BA 1in	32p
LR56L	C/S Screw 6BA 1/4in	9p
BF12N	C/S Screw 6BA 1/2in	19p
BF13P	C/S Screw 6BA 1in	35p
LR00A	C/S Screw 8BA 1/2in	29p
BF14Q	Panel Screw	3p
LR75S	C/S Panel Screw	5p
BF16S	Nut 2BA	19p
BF17T	Nut 4BA	19p
BF18U	Nut 6BA	12p
BF19V	Nut 8BA	12p
BF20W	Washer 2BA	12p
BF21X	Washer 4BA	9p
BF22Y	Washer 6BA	9p
BF23A	Washer 8BA	9p
LR76H	Cup Washer	2p
BF24B	Shake 2BA	9p
BF25C	Shake 4BA	9p
BF26D	Shake 6BA	9p
LR01B	Shake 8BA	8p
BF27E	Tag 2BA	12p
BF28F	Tag 4BA	9p
BF29G	Tag 6BA	13p
LR02C	Tag 8BA	11p

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BF30H	Pozi Screw M5 6mm	23p
BF31J	Pozi Screw M5 12mm	33p
BF32K	Pozi Screw M5 25mm	33p
BF33L	Pozi Screw M4 6mm	25p
BF34M	Pozi Screw M4 12mm	32p
BF35Q	Pozi Screw M4 25mm	27p
BF36P	Pozi Screw M3 6mm	13p
LR57M	Pozi Screw M3 9mm	13p
BF37S	Pozi Screw M3 12mm	15p
BF38R	Pozi Screw M3 25mm	27p
LR58N	Pozi Screw M3 40mm	33p
BF39N	Pozi Screw M2.5 6mm	15p
BF40T	Pozi Screw M2.5 12mm	18p
BF41U	Pozi Screw M2 6mm	29p
BF46A	Isobolt M5 12mm	55p
BF48C	Isobolt M4 6mm	26p
BF49D	Isobolt M4 12mm	33p
BF50E	Isobolt M4 25mm	57p
BF51F	Isobolt M3 6mm	20p
BF52G	Isobolt M3 12mm	26p
BF53H	Isobolt M3 25mm	35p
BF54J	Isobolt M2.5 6mm	19p
BF55K	Isobolt M2.5 12mm	24p
BF56L	Isonut M5	20p
BF57M	Isonut M4	20p
BF58N	Isonut M3	15p
BF59P	Isonut M2.5	14p
LR59P	Isonut M2	10p
BF60Q	Isowasher M5	15p
BF61R	Isowasher M4	9p
BF62S	Isowasher M3	9p
BF63T	Isowasher M2.5	9p
LR60Q	Isowasher M2	7p
BF42V	Isoshake M5	12p
BF43W	Isoshake M4	9p
BF44X	Isoshake M3	9p
BF45Y	Isoshake M2.5	9p
LR61R	Isoshake M2	9p

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LR62S	Isotag M5	18p
LR63T	Isotag M4	20p
LR64U	Isotag M3	12p
LR65V	Isotag M2.5	12p
LR66W	Isotag M2	9p
BF68Y	Slf-Tpr No.8 x 3/8in	22p
BF69A	Slf-Tpr No.8 x 1/2in	25p
LR67X	Slf-Tpr No.6 x 3/8in	20p
BF67X	Slf-Tpr No.6 x 1/2in	22p
BF65V	Slf-Tpr No.4 x 3/8in	15p
BF66W	Slf-Tpr No.4 x 1/2in	16p
BF64U	Slf-Tpr No.2 x 3/16"	12p
LR68Y	Slf-Tpr No.2 x 3/8in	14p
BF70M	Nyl 2BA 1/2in	86p
BF71N	Nyl 2BA 1in	95p
BF72P	Nyl 4BA 1/2in	39p
BF73Q	Nyl 4BA 1in	55p
BF74R	Nyl 4BA 1.1/2in	£1.55
BF75S	Nyl 6BA 1/2in	50p
BF76H	Nyl 6BA 1in	60p
BF77J	Nyl 8BA 1/2in	60p
BF78K	Nyl Nut 2BA	55p
BF79L	Nyl Nut 4BA	55p
BF80B	Nyl Nut 6BA	53p
BF81C	Nyl Nut 8BA	55p
BF82D	Nyl Washer 2BA	18p
BF83E	Nyl Washer 4BA	18p
BF84F	Nyl Washer 6BA	18p
BF85G	Nyl Washer 8BA	26p
WH18U	Nyl C/S Scw M3 x12mm	4p
WH19V	Nylon Nut M3	4p
BF15R	Spring Clip	4p
YW94C	Batten Clip	4p
LB99H	Blk Wdscrw No 4 1/2"	15p
BH44X	Plas Fixing	12p
YL23A	Hand Wheel Bolt	35p
FW10L	Spade 2BA	28p
FW11M	Spade 4BA	23p
FW13P	Studding 2BA	32p
FW14Q	Studding 4BA	30p
FW15R	Studding 6BA	30p
FW30H	4BA Spacer 1/8in	38p
FW31J	4BA Spacer 1/4in	48p
FW32K	4BA Spacer 1/2in	52p
FW33L	6BA Spacer 1/8in	35p
FW34M	6BA Spacer 1/4in	38p
FW35Q	6BA Spacer 1/2in	49p
LR69A	8BA Spacer 1/8in	32p
LR70M	8BA Spacer 1/4in	36p
LR71N	Thrded Spcr 4BA	78p
LR72P	Thrded Spcr 6BA	59p

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FW16S	Standoff Short	5p
FW17T	Standoff Medium	6p
FW18U	Standoff Long	7p
LR03D	Terry Clip 1/2in	10p
LR73Q	Terry Clip 1.1/2in	26p
FW59P	Grommet Small	2p
FW60Q	Grommet Large	2p
LR47B	SR Grommet 3P-4	6p
LR48C	SR Grommet 5M-3	7p
LR49D	SR Grommet 6W-1	10p
LR50E	SR Grommet 7K-2	26p
LR51F	Sealing Grommet	8p
BL74R	Flexigrommet A	24p
BL75S	Flexigrommet B	29p
BL76H	Flexigrommet C	31p
FW36P	Hole Plug 1/4in	5p
FW37S	Hole Plug 3/8in	7p
HB22Y	Quickstick Pads	9p
HB21X	Velcromounts	12p
LQ12N	Sealing Strip	79p

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LH12N	Aly Sheet 18 swg	£1.59
LH13P	Aly Sheet 16 swg	£3.85
LW21X	Mixer Trim 4	DIS
LW22Y	Mixer Trim 8	DIS
LW23A	Mixer Trim 12	DIS
LW24B	Mixer Trim 16	DIS
LW17T	Mixer Mtg Tube 4	£1.10
LW18U	Mixer Mtg Tube 8	DIS
LW19V	Mixer Mtg Tube 12	DIS
LW20W	Mixer Mtg Tube 16	DIS
WH48C	Mains Warning Label	15p
XX31J	PCB Guides	25p
XH39N	Transfer 1/8in Black	£1.35
XH40T	Transfer 1/8in Red	£1.56
XH41U	Transfer 1/8in White	£1.56
XH42V	Transfer 1/4in Black	£1.56
XH43W	Transfer 1/4in Red	£1.45
XH44X	Transfer 1/4in White	£1.35
XH45Y	Panel Transfer Black	£1.56
XH46A	Panel Transfer Red	£1.56
XH47B	Panel Transfer White	£1.35

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KNOBS

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RW75S	Knob BK12	16p
RW77J	Knob PN20	[illegible]
RX99H	Knob RN92	28p
RW87U	Knob KB4	22p
RW86T	Knob KB3	45p
RX09K	Knob R78	58p
HB23A	Knob K1	73p
HB24B	Knob K2	39p
HB19V	Knob RK401	95p
HB57M	Knob RK403	£1.55
RW88V	Knob M1	38p
RW89W	Knob M2	30p
RW90X	Knob M3	25p
RX00A	Knob M4	45p
RX10L	Knob R81	45p
RX11M	Knob 82	55p

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RW78K	Knob F10	35p
HB26D	Knob F11	31p
RX01B	Knob NK2	45p
RX02C	Knob PK2	45p
YX01B	Knob K7A	24p
YX02C	Knob K7B	27p
YX03D	Knob K7C	32p
YX04E	Knob K7D	49p
HB28F	Knob R51	52p
HB29G	Knob R52	53p
RX07H	Knob R76	55p
RX08J	Knob R77	64p
HB30H	Knob R53	69p
HB31J	Knob R54	96p
YR64U	Knob K8A	43p
YR65V	Knob K8B	56p
YR66W	Knob K8C	64p
HB34M	Knob K105L	95p
HB35Q	Knob K106L	£1.74
HB32K	Knob K105	59p
HB33L	Knob K106	95p
HB36P	Knob K15	55p
HB37S	Knob K24	75p
HB38R	Knob K30	72p
HB39N	Knob K44	69p
HB40T	Knob K45	79p
HB41U	Knob K46	£1.15

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RX16S	Collet Knob Black	38p
RX17T	Collet Knob Grey	45p
WL45Y	15mm Collet Cap Blk	5p
WL46A	15mm Collet Cap Blue	5p
WL47B	15mm Collet Cap Grn	5p
WL48C	15mm Collet Cap Grey	5p
WL49D	15mm Collet Cap Red	5p
WL50E	15mm Collet Cap Yllw	5p
WL51F	15mm Collet Pntr Blk	5p
WL52G	15mm Collet Pntr Blu	5p
WL53H	15mm Collet Pntr Grn	5p
WL54J	15mm Collet Pntr Gry	5p
WL55K	15mm Collet Pntr Red	5p
WL56L	15mm Collet Pntr Ylw	5p
RX18U	15mm Collet Nut Cvr	13p
RX19V	15mm Collet Indctr	18p
RX20W	15mm Collet Skirt	21p
RX21X	15mm Collet Stator	19p
*WL43W	Collet Rd Nut 3/8in	16p
*WL44X	Collet Rd Nut 10mm	16p
RX22Y	Slide Knob A	15p
YG09K	Slide Knob B	19p
YG10L	Slide Knob C Black	20p
YG11M	Slide Knob C Chrome	29p
RX24B	Slide Knob F Blk	17p
RX25C	Slide Knob F Blue	17p
RX26D	Slide Knob F Green	17p
RX27E	Slide Knob F Grey	17p
RX28F	Slide Knob F Red	17p
RX29G	Spindle Coupler	49p
RX30H	Ext Spindle	69p
*RX38R	Nylon Rod	14p
RX45Y	Cord Drive Brass	89p
RX46A	Cord Drive Steel	£1.39

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RX31J	Brass Bush	53p
BL73Q	Drive Cord	7p
RX43W	Cord Drum Small	£1.05
RX94C	Cord Drum Large	£1.05
RX44X	Flywheel	£3.35
RX39N	Vernier Dial Small	£2.35
RX40T	Vernier Dial Medium	£2.95
RX41U	Vernier Dial Large	£3.55
RX42V	Ball Drive	£2.35
HB42V	Mini Ball Drive	£1.95
HB43W	DR Drive Scale	£9.75
HB45Y	Aluminium Dial	£4.75
HB46A	White Pointer	35p
HB47B	Ball Drive Pointer	55p
HB48C	Spring Short	9p
HB49D	Spring Medium	9p
HB50E	Spring Long	9p
RX95D	Pulley 1/2in	14p

MICROPHONES

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LB92A	Phone Coil	95p
LB93B	Crystal Mic Insert	50p
LB68Y	Lapel Mic	£1.28
YW69A	Stick Mic	DIS
YB31J	Cassette Mic Jacks	£1.95
YB32K	Cassette Mic DIN	£2.75
YB33L	Electret Cssette Mic	£2.95
WF35Q	Dynamic Ball Mic	£9.93
LH86T	Long Stem Mic	DIS

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LH87U	Dynamic Stereo Mics	£10.25
WF05F	Communications Mic	£5.75
YW70M	Diff Comm Mic	£8.25
YW77J	Mic Hldr Screw Fix	28p
YW78K	Mic Hldr Adhesive	49p
YW79L	Mic Hldr Magnetic	52p
XY72P	Base Station Mic	£24.75
LB69A	Tie Clip Mic	£7.85

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YW71N	UM Tie Clip Mic	£12.45
YB34M	Low Cost Elect Mic	DIS
YB35Q	Eletret Mic 8CM31	£10.45
WF34M	Electret Mic Dual-Z	£16.75

Note: For details of software, please ask for leaflet XH52G (Issue 2 now available).

1981 Catalogue Page No.		VAT inclusive PRICE
YB36P	Unisound Mic EM82D	£19.17
YB37S	Unisound Mic EM83D	£20.85

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WY06G	Super Cardioid Mic	£23.55
WY07H	Stereo Electret Mic	£19.75
•YB38R	Unisnd Mic DM1500D	£35.45
LB94C	Screen S15	£6.58
LB95D	Mic Unit U15	£10.75
LB35Q	Mic Windshield	45p
YW72P	Gsneck Mic Stand 8in	£1.99
LH68V	Gsneck Mic Stnd 12in	£2.95
WF36P	Gsneck Mic Stnd 21in	£3.45
YW73Q	Plastic Gsneck Base	65p
YW74R	Metal Gsneck Base	£3.25
WF37S	Bkt For Gsnk Stand	£1.95

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LB96E	Table Top Mic Stand	£2.25
YW75S	Cast Base Mic Stand	£3.85
YW76H	Extra Hgt Mic Stand	£6.95
XB45Y	5 Foot Mic Stand	£13.45
XB46A	Boom Arm	£12.65

MUSICAL

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LB97F	Pre Amp EQ2S	£3.45
YB39N	Pre Amp CS5	£8.43
XB30H	Mono Mic Mixer	£8.65
XB29G	Stereo Mixer	£22.88
LB66W	Mini Phaser	£19.77
YB30H	Fuzz Box	£15.25

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XB41U	Fuzz Wah Pedal	£29.50
XB34M	Vibra Chorus	£57.30
YB88V	Mini Compressor	£21.20
XB33L	Echo Chamber	£67.33
LB67X	Echo Chamber Tape	£4.99
XY80B	BBD Echo Machine	£72.50

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YB40T	Cry Guitar Pick-Up	£3.93
YB41U	Nylon Mag Pick-Up	£7.30
YB42V	Steel Mag P.U	£8.45
YL08J	Pickup Transl.AJ21	£27.95
YL09K	Pickup Transl.AJ51	£19.95
YL10L	Pickup Transl.AJ15	DIS
YL07H	Pickup Switch	£2.65
LB78K	Guitar Strings Nylon	£1.85
LB60Q	Guitar Strings Steel	£1.55
LB98G	Strap Button	55p

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RX86T	MES Batten Hldr	21p
RX57M	Holder MES Amber	£1.45
RX58N	Holder MES Blue	DIS
RX59P	Holder MES Clear	£1.45
RX60Q	Holder MES Green	£1.45
RX51R	Holder MES Red	£1.45
RX76H	Dmd LES Lhldr Blue	35p
RX77J	Dmd LES Lhldr Green	35p
RX78K	Dmd LES Lhldr Red	35p
RX79L	Dmd LES Lhldr White	35p
RX80B	Dmd LES Lhldr Yellow	35p
RX67X	Flt-Tp LES Lhldr Blu	35p
RX68Y	Flt Tp LES Lhldr Grn	35p
RX69A	Flt-Tp LES Lhldr Red	35p
FF66W	Fluted Lhldr Amber	30p
FF67X	Fluted Lhldr Clear	30p
FF68Y	Fluted Lhldr Green	30p
FF69A	Fluted Lhldr Red	30p
YY00A	LES Cover Amber	6p
YY01B	LES Cover Blue	6p
YY02C	LES Cover Green	6p
YY03D	LES Cover Purple	6p
YY04E	LES Cover Red	6p
YY05F	LES Cover White	6p
YY06G	LES Cover Yellow	6p
RX82D	Pan Neon Amber	55p■
RX83E	Pan Neon Red	75p
RX81C	Square Neon Red	33p
RX98G	Square Neon Green	33p
RX70M	Wire Neon	14p
WQ13P	Wire Bulb 12V	30p
WL74R	LES Bulb 6V	17p
WL75S	LES Bulb 12V	15p
RX84F	Neon Bulb	99p

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WL76H	Bulb MES 3.5V	35p
WL77J	Bulb MES 6V 0.24W	36p
WL78K	Bulb MES 6V 6W	31p
WL79L	Bulb MES 6.5V	27p
WL80B	Bulb MES 12V 1.2W	28p
WL81C	Bulb MES 12V 2.2W	29p
WL82D	Bulb MES 24V	36p
LQ10L	Portable Lamp	£6.95
XY71N	Caravan Lamp	£9.65
LQ11M	12V Tube	£1.38
LL15R	240V Inspection Lamp	£5.60
XQ15R	Bulkhead	£4.35
XR64U	Festoon Cable	DIS
YW45Y	Festoon Lampholder	DIS
HB52G	Pygmy Bulb Blue	90p
HB53H	Pygmy Bulb Green	90p
HB54J	Pygmy Bulb Red	90p
HB55K	Pygmy Bulb White	70p
HB56L	Pygmy Bulb Yellow	90p
XY25C	Stay-Put Lamp	DIS
YB29G	Spot Holder	£3.85

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XY00A	3-Bank Lampholder	DIS
XB31J	BC Clip-On Hdr Sngl	£4.99
XB32K	BC Clip-On Hdr Twin	£6.95
WF25C	Spot Lamp Amber	£2.85
WF26D	Spot Lamp Blue	£2.85
WF27E	Spot Lamp Clear	£2.35
WF28F	Spot Lamp Green	£2.85
WF29G	Spot Lamp Red	£2.85
WF30H	Spot Lamp Violet	£2.85
WF22Y	Gooseneck Lamp	£5.32
WL32K	Mini LED Red	10p
WL33L	Mini LED Green	19p
WL34M	Mini LED Orange	27p
YY38R	Mini LED Yellow	19p
YY39N	Mini LED Clip	2p
WL27E	LED Red	12p
WL28F	LED Green	19p

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WL29G	LED Orange	33p
WL30H	LED Yellow	17p
YY40T	LED Clip	2p
QW96E	Square LED Red	36p
YH60Q	Square LED Green	36p
YH61R	Square LED Yellow	40p
YH62S	Square LED Clip	7p
YY41U	Large LED Red	£1.49
YY42V	Large LED Clip	21p

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YY45Y	Shape LED R1 Red	20p
YY46A	Shape LED R1 Green	25p
YY47B	Shape LED R1 Orange	37p
YY48C	Shape LED R1 Yellow	27p
YY49D	Shape LED S2 Red	20p
YY50E	Shape LED S2 Green	27p
YY51F	Shape LED L3 Red	21p
YY52G	Shape LED L3 Green	26p
YY53H	Shape LED L3 Yellow	26p
YY54J	Shape LED T4 Red	22p
YY55K	Shape LED T4 Green	26p
YY56L	Shape LED T4 Yellow	26p
YY57M	Shape LED A5 Red	23p
YY58N	Shape LED A5 Green	27p
YY43W	Illuminator Orange	NYA
YY44X	Illuminator Yellow	NYA
YH53H	Cliplite Amber	16p
YH54J	Cliplite Clear	16p
YH55K	Cliplite Green	16p
YH56L	Cliplite Red	16p
YH57M	Cliplite Yellow	16p
YY61R	Multicolour LED	59p
YY59P	Chrome LED Small	52p
YY60Q	Chrome LED Large	54p
BY65V	Red Bargraph Dslpy	£3.25
YG33L	Green Bargraph Dslpy	£2.95
YG34M	Ornge Bargraph Dsply	£2.95
YG35Q	Yllow Bargraph Dsply	£3.35

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FR36P	7-Seg Red Type 1	£1.07
FR37S	7-Seg Red Type 3	DIS
FR38R	7-Seg Red Type 4	£1.25
FR39N	"1/2" Display Type 1	99p
FR40T	"1/2" Display Type 3	DIS
FR41U	"1/2" Display Type 4	£1.07
BY66W	DD Display Type A	£1.98
BY67X	DD Display Type AF	50p
BY68Y	DD Display Type C	£1.98

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XX08J	4-Dig Dspy Cmn Cath	£2.69
BY70M	4 Dig Dis Cmn Anode	£1.50
HQ36P	Mult Cmn Cath Disply	£3.45
FR32K	Filter Amber	85p
FR33L	Filter Green	£1.20
FR34M	Filter Red	85p
FR35Q	Filter Yellow	65p
FY89W	Lqd Crystal Display	£5.50

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WL35Q	Opto-Isolator	69p
YY62S	Dual Opto-Isolator	£1.31
YY63T	Quad Opto-Isolator	£2.86
WQ70M	Darlington Isolator	74p■
YY64U	SCR Isolator	£2.12
QQ10L	Triac Isolator	£1.55

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YH70M	IR Emitter TIL38	49p
YH71N	Photodiode TIL100	93p
YY65V	Infra-Red Source	38p
YY66W	Infra-Red Sensor	31p
BL23A	MS4A	£2.95
QF30H	BPX25	£2.70

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HQ61R	MEL 12	38p■
YQ62S	Xenon Tube	£2.40
YQ63T	Trigger Transfmr	49p
*XR56L	1mm Light Guide	67p
XL11M	Laser Tube	£124.00
HY19V	5KV Laser PCB	£4.50
HQ63T	Lens	£2.15
HQ64U	Lensholder	69p

ORGAN PARTS

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QL02C	SAM77	£1.20

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XB10L	DMO2	£14.82
XB11M	DMO2T	£16.82

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XL08J	Short Spring Line	£5.53
XB84F	Long Spring Line	£11.13
XB85G	MES Driver Module	£6.95
YL17T	Reverb PSU Module	£4.73
XB17T	Mid Kbd 49-Note C-C	£20.87
XB13P	KB Mounting Strip	39p

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XB14Q	Keyboard 48-Note	£23.94
XB15R	Keyboard 49-Note	£23.95
XB16S	Keyboard 61-Note	£28.95
XB94C	Contact Block 1WG	29p
XB01B	Contact Block GJ	45p
XB02C	Contact Block GB2	67p
XB03D	Contact Block GC3	DIS
XB04E	Earth Bar	23p
XB00A	Gold Wire	£1.10
XB86T	Spacesnd Mid-Range	£52.66

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XB87U	Rotating Horns Unit	£79.30
FL66W	Stop Tab Black	75p
FL67X	Stob Tab Blue	75p
FL68Y	Stop Tab Green	75p
FL69A	Stop Tab Grey	75p
FL70M	Stop Tab Ivory	75p
FL71N	Stop Tab Maroon	75p
FL72P	Stop Tab Orange	75p
FL73Q	Stop Tab Red	75p
FL74R	Stop Tab White	75p

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FL75S	Stop Tab Yellow	75p
BR05F	S Tab Acc Del Trem	£1.10
BR47B	S Tab Bass Guitar	£1.10
BR67X	S Tab Bourdon 8'	£1.10
BR06G	S Tab Cello 16'	£1.10
BR07H	S Tab Clarinet 8'	£1.10
BR08J	S Tab Clarion 4'	£1.10
BY00A	S Tab Clavichord	£1.10
BY01B	S Tab D/B to Rotor	£1.10
BY02C	S Tab Dly Vbrato Acc	£1.10
BY03D	S Tab Dly Vbrto Solo	£1.10
BR09K	S Tab Diapason 8'	£1.10
BR68Y	S Tab Diapason 16'	£1.10
BR10L	S Tab Drawbars Acc	£1.10
BR11M	S Tab Drawbars Solo	£1.10
BR12N	S Tab Dulciana 8'	£1.10
BR13P	S Tab Flute 1'	£1.10
BR14Q	S Tab Flute 2'	£1.10
BR15R	S Tab Flute 2.2/3'	£1.10
BR16S	S Tab Flute 4'	£1.10
BR17T	S Tab Flute 5.1/3'	£1.10
BR18U	S Tab Flute 8'	£1.10
BR19V	S Tab Flute 16'	£1.10
BR20W	S Tab French Horn 8'	£1.10
BR21X	S Tab Gedeckt 8'	£1.10
BY05F	S Tab Gedeckt 16'	£1.10
BY06G	S Tab Honky Tonk	£1.10
BR22Y	S Tab Horn 8'	£1.10
BY07H	S Tab Mixture 16'	£1.10
BR23A	S Tab Oboe 8'	£1.10
BR24B	S Tab Octave 4'	£1.10
BR25C	S Tab Pedal Sustain	£1.10
BY08J	S Tab Piano	£1.10
BY09K	S Tab Presets Cancel	£1.10
BY10L	S Tab Prsts to Rotor	£1.10
BY11M	S Tab Reed 4'	£1.10
BR26D	S Tab Reverb	£1.10
BY12N	S Tab Rotor Fast	£1.10
BY13P	S Tab Rotor To Main	£1.10
BR27E	S Tab Salicet 4'	£1.10
BR28F	S Tab Salicional 8'	£1.10
BR29G	S Tab Saxophone 16'	£1.10
BR30H	S Tab Solo Del Trem	£1.10
BR31J	S Tab String 4'	£1.10
BR32K	S Tab String 8'	£1.10
BR33L	S Tab Sub Bass 16'	£1.10
BY14Q	S Tab Sustain Acc	£1.10
BY15R	S Tab Sustain Solo	£1.10
BR34M	S Tab Tremulant	£1.10
BR35Q	S Tab Trumpet 8'	£1.10
BR36P	S Tab Tuba 16'	£1.10
BY16S	S Tab Vibrato	£1.10
BR37S	S Tab Vox Anglica 8'	£1.10
BR38R	S Tab Vox Humana 8'	£1.10
BY17T	Mar Ky Tab Cello 16'	£3.45
BY18U	Mar Key Tab Clar 8'	£3.45
BY19V	Mar Ky Tab Clrion 4'	£3.45
BY20W	Mar Key Tab Clav	£3.45
BY21X	Mar Ky Tb D/B to Rtr	£3.45
BY22Y	Mr Ky Tb Dly Vbr Acc	£3.45
BY23A	Mr Ky Tb Dly Vbr Slo	£3.45
BY24B	Mar Key Tab Diap 8'	£3.45
BY25C	Mar Key Tab Diap 16'	£3.45
BY26D	Mar K Tab Dbar Acc	£3.45
BY27E	Mar K Tab Dbar Solo	£3.45
BY28F	Mar Key Tab Dulc 8'	£3.45
BY29G	Mar Key Tab Flute 1'	£3.45
BY30H	Mar Key Tab Flute 2'	£3.45
BY31J	Mr Ky Tb Flte 2.2/3'	£3.45
BY32K	Mar Key Tab Flute 4'	£3.45
BY33L	Mr Ky Tb Flte 5.1/3'	£3.45
BY34M	Mar Key Tab Flute 8'	£3.45
BY35Q	Mar Key Tab Flute 16'	£3.45
BY36P	Mr Ky Tb Frch Hrn 8'	£3.45
BY37S	Mar Key Tab Gedkt 8'	£3.45
BY38R	Mr Key Tab Gedkt 16'	£3.45
BY39N	Mar Key Tab Hnky Tnk	£3.45
BY40T	Mar Key Tab Horn 8'	£3.45

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BY41U	Mar Key Tab Mix 16'	£3.45
BY42V	Mar Key Tab Oboe 8'	£3.45
BY43W	Mar Key Tab Octve 4'	£3.45
BY44X	Mar Key Tab Pdl Sus	£3.45
BY45Y	Mar Key Tab Piano	£3.45
BY46A	Mr Ky Tb Prsts Cncl	£3.45
BY47B	Mr Ky Tb Prsts To Rr	£3.45
BY48C	Mar Key Tab Reed 4'	£3.45
BY49D	Mar Key Tab Reverb	£3.45
BY50E	Mar Key Tab Rtr Fst	£3.45
BY51F	Mr Ky Tb Rtr To Main	£3.45
BY52G	Mar Ky Tab Salict 4'	£3.45
BY53H	Mar Key Tab Salic 8'	£3.45
BY54J	Mar Key Tab Sax 16'	£3.45
BY55K	Mar Key Tab Strng 4'	£3.45
BY56L	Mar key Tab Strng 8'	£3.45
BY57M	Mar Ky Tb Sb-Bss 16'	£3.45
BY58N	Mar Key Tab Sus Acc	£3.45
BY59P	Mar Key Tab Sus Solo	£3.45
BY60Q	Mar Key Tab Trmpt 8'	£3.45
BY61R	Mar Key Tab Tuba 16'	£3.45
BY62S	Mar Key Tab Vibrato	£3.45
BY63T	Mar K Tab Vox Ang 8'	£3.45
BY64U	Mar K Tab Vox Hum 8'	£3.45
FL76H	Key Tab	90p
BR46A	ST Strip	£1.35
XX13P	KT Strip	£1.50
BR41U	Drawbar Red	£1.35
BR42V	Drawbar White	£1.35
XB18U	Contact Pedal Board	£22.30
XB19V	Free-Stdg Pedalboard	£63.00

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XB99H	Pdl Unit Front Panel	£2.95
XB96E	32-Note Pdlbd	£135.41
	Carr in UK with XB96	£14.30
XB22Y	Control Lever	£7.73
XB21X	Piano Pedal	£10.95
XB20W	Swell Pedal	£8.50
XY28F	Remote Foot Control	£9.85

PANEL METERS

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RW74R	Level Meter	£4.35
LB80B	Sig Strength Meter	£1.95
LB79L	Tuning Meter	£1.95
RW73Q	VU Meter V41	£2.20
YQ47B	Dual VU Meter	£3.90
RW97F	2in.Pn Mtr 50-0-50uA	£6.65
RW98G	2inPn Mt 100-0-100uA	£6.65
RW99H	2inPn Mt 500-0-500uA	£6.65
RW91Y	2in. Pan Meter 50uA	£6.45
RW92A	2in. Pan Meter 100uA	£6.45
RW93B	2in. Pan Meter 500uA	£6.45

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RW94C	2in. Pan Meter 1mA	£6.45
RW95D	2in. Pan Meter 5mA	£6.45
RW96E	2in. Pan Meter 10mA	£6.45
RX32K	2in. Pan Meter 50mA	£6.65
RX33L	2in. Pan Meter 100mA	£5.55
RX34M	2in. Pan Meter 500mA	£6.45
RX35Q	2in. Pan Meter 1A	£5.85■
RX36P	2in. Pan Meter 50V	£6.65
RX37S	2in. Pan Meter 300V	£5.90
RX52G	2in. Pan Meter 'S'	£6.65
RX53H	2in. Pan Meter 'VU'	£6.65

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YG17T	Meter MS45 100uA	DIS
YG18U	Meter MS45 1mA	DIS
YG19V	Meter MS45 VU	£4.45
RX54J	Large Panel Meter	£7.59
RX55K	Illuminating Kit	DIS
RX92A	Meter MI 15V	£6.95
RX87U	Meter MI 60V	£6.35
RX88V	Meter MI 300V	£7.96
RX89W	Meter MI 1A	£6.20
RX90X	Meter MI 5A	£6.95
RX91Y	Meter MI 15A	£7.65
RX93B	Meter MI 25A	£7.95

PCB EQUIPMENT

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FL01B	SRBP 0.1in Type 2	DIS
FL02C	SRBP 0.1in Type 3	99p
YR80B	SRBP 0.1in Type 4	DIS
FL06G	Vero 14354	25p
FL07H	Vero 10345	£1.06
FL08J	Vero 10346	89p
FL09K	Vero 10347	£1.19
FL10L	Vero 10348	£1.05
YR81C	Vero 21002	DIS
FL53H	Vero 10401	£3.65
FL17T	Verostrip	99p
FL19V	DIP Board	£4.35
HQ48C	Vero V-Q Board	£1.95
FL25C	Tool 2022	£1.45
FL26D	Tool 2150	£1.95
FL27E	Tool 2151	£1.95
FL20W	Pin 2140	60p
FL21X	Pin 2141	55p
FL23A	Pin 2144	55p
FL24B	Pin 2145	57p

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FL80B	Pin 0266 Pk of 10	25p
FL81C	Pin 1657 Pk of 10	35p
FL82D	Track Pin	85p
FL28F	4-Way Tag	12p
FL29G	Mounting Strip	32p
FL11M	Tag Board	94p
YL11M	Vero Plugblock	£4.95
YR83E	Eurobreadboard	£6.75
YR84F	Prof Plugblock	£6.95

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YR85G	Bus-Strip Plugblock	£2.95
YR86T	Plugblck Contct Strp	28p
YR87U	Plugblock PCB	£1.85
XB43W	Seno Etch System	£6.99
XY10L	UV Exposure Box	£41.32
BW19V	Photo-Etch PCB	£2.95
BW20W	Phot-Etch Drftg Pk	£1.95

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XX12N	Etch Crystals	£1.25
WF10L	Etcher Fluid	£2.25
HX02C	PCB Pen	£1.35
HX03D	Resist Remover	88p
HX00A	PCB SRBP Smll Single	48p
WF38R	PCB SRBP Med Single	96p
WF39N	PCB SRBP Lrg Single	£1.25
HX01B	PCB F.Glass Sm Sngl	85p
WF40T	PCB F.Glass Med Sngl	£1.75
WF41U	PCB F.Glass Lrg Sngl	£2.75
WF42V	PCB F.Glass Med Dble	£1.39
XB90X	Fixircuit	£8.75
BW21X	Track Tape 31	91p
BW22Y	Track Tape 40	91p
BW23A	Track Tape 50	91p
BW24B	Track Tape 62	£1.32
BW25C	Track Tape 80	£1.32
BW26D	Track Tape 100	£1.32
BW27E	Track Tape 125	£1.85
BW28F	Track Tape 150	£1.85
BW29G	Track Tape 200	£1.85
BW30H	Pad 075	£1.55
BW31J	Pad 100	£1.55
BW32K	Pad 125	£1.12
BW33L	Pad 150	£1.12
BW34M	Pad 200	£1.50
BW35Q	Pad 300	£1.50
BW36P	Pad 400	£2.55
BW37S	Pad 500	£3.95
BW38R	Pad 600	£5.25

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BW40T	IC Pads 200	£4.65
BW41U	Drafting Template	88p
HX45Y	Transfer Sheet 1	42p
HX46A	Transfer Sheet 2	42p
HX47B	Transfer Sheet 3	42p
HX48C	Transfer Sheet 4	42p
HX49D	Transfer Sheet 5	42p
HX63T	Transfer Sheet 6	42p
HX64U	Transfer Sheet 7	42p
HX65V	Transfer Sheet 8	42p
HX66W	Transfer Sheet 9	42p
HX67X	Transfer Sheet 10	42p
HX68Y	Transfer Sheet 11	42p
HX83E	Transfer Sheet 12	42p
HX84F	Transfer Sheet 13	42p
HX44X	Transfer Kit	£3.75

PROJECTS

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XF11M	MES12	£2.00NV
XH24B	MES15	15pNV
XH27E	MES16	15pNV
XH18U	MES22	25pNV
XH06G	MES24	FREE
XH20W	MES25	25pNV
XF03D	MES26	£1.20NV
XH51F	MES30	20pNV
XH07H	MES32	DIS
XH48C	MES33	40pNV
XH21X	MES37	25pNV

1981 Catalogue Page No.		VAT inclusive PRICE
XF04E	MES41	40pNV
XH23A	MES42	25pNV
XH49D	MES47	DIS
XH19V	MES49	DIS
XH00A	MES51	15pNV
XH02C	MES52	15pNV
XH04E	MES53	35pNV
XH31J	MES54	30pNV
XH33L	MES55	30pNV
XH35Q	MES56	NYA
XH26D	MES71	30pNV
XH50E	MES93	DIS
XF36P	81 Maplin Catalogue	£1.25NV
XF08J	MES120	FREE
LW50E	Electronics For All	£29.95

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BR45Y	AS314	33p
BR88V	Mk/Space Adptr Kit	£3.95
YL20W	Mstr Tuning Module	£19.87
BB00A	Divider Board 'A'	£4.35
BB01B	Divider Board 'B'	£3.20
BB02C	Tone Board 'A'	£4.45
BB03D	Tone Board 'B'	£1.98
BB07H	Control Board 'A'	£4.25
BB08J	Control Board 'B'	£2.98
BB09K	Sawtooth Board 'A'	£4.25
BB10L	Sawtooth Board 'B'	£4.85
BB11M	Gate Board	44p
BB04E	Tone Board 'C'	£4.85
BB05F	Tone Board 'D'	£4.82
BB06G	Tone Board 'E'	£4.55
BB12N	Pedal PCB 'A'	£2.20
BB15R	Mother Board 'A'	£10.30
BB13P	A/B Switch Board	£1.68
BB14Q	MES Amp Board 'A'	72p
BB77J	Divider MO & Frq Gen	£4.95
BB78K	Pedal PCB 'B'	£3.87
BB79L	32-Note Pedal Voice	£4.45
BB80B	Pedal Diode PCB	£1.65
HQ72P	Auto Ogn Gen/Clk PCB	£3.95
·HQ73Q	Auto Ogn Crd Cdr PCB	£3.75
HQ74R	Auto Ogn Auto St PCB	£5.95
HQ75S	Auto Ogn PA/PSU PCB	£4.35
YL00A	Organ Mixer PCB	£3.25
YL18U	Power Supply 2G05	£1.35
YL21X	32 Note Pdl PSU PCB	£2.95
XX38R	Downbeat Indictr PCB	£2.20
XH00A	MES51	15pNV
XH02C	MES52	15pNV
XH04E	MES53	35pNV
XH31J	MES54	30pNV
XH33L	MES55	30pNV

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XF11M	MES12	£2.00NV
BB41U	Synth Mixer PCB	£3.95
BB44X	Synth VCA PCB	£1.36
BY87U	Synth Preset Mtg Bd	65p
BY88V	Synth 1979 Kybd Cont	£5.95
BY89W	Synth Binary Encoder	£7.95
BB40T	Synth PSU Mk.II PCB	£4.95
BY90X	Synth Smpl & Nse PCB	£3.95
BB43W	Synth Trns Gen 1 PCB	£3.20
BB45Y	Synth Trns Gen 2 PCB	£3.20
BY81C	Synth Trns Rept PCB	£1.24
BY82D	Synth Rvrb & Phs PCB	£3.20
BY83E	Synth VC Pn & AncPCB	£6.65
BB38R	Synth Oscillator PCB	£3.25
BB48C	Synth Ext I/P's PCB	£1.54
BB65V	3600 VCF PCB	£2.17
BB64U	4600 Hinge	63p
BB63T	Synth Ext I/P's Bkt	64p
BB49D	Synth Oscltr Mtg Bkt	67p■
BB52G	Synth Mixer Chassis	£2.10
BB51F	Synth Pwr Sply Htsnk	£1.30
BB56L	Synth Mixer Mtg Bkt	16p
BB58N	Synth Trns 1/Env Bkt	85p
BB59P	Synth Trns 2 Mtg Bkt	£1.20
BB60Q	Synth VCA Mtg Bkt	52p
BB61R	Synth VCF Mtg Bkt	64p
BF95D	Joylever PCB	99p
XQ01B	5600 Front Panel	£13.50
	Carr in UK with XQ01	£9.00
BY84F	5600 Rear Panel	£4.55
XQ02C	5600 Cabinet	£55.23
	Carr in UK with XQ02	£9.00
XB79L	Teak 5600 Cabinet	£55.70
	Carr in UK with XB79	£7.00

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BY86T	3800 Interface PCB	£2.29
BB47B	Synth Otpt Stge PCB	£4.55
XQ03D	3800 Front Panel	£9.73
	Carr In UK With XQ03	£8.00
BF96E	3800 Sp.Ext.I/P.Bkt	55p
BF98G	3800 VCA Bkt	55p
BF99H	3800 Intface Mtg Bkt	55p
•BB67X	3600 VCF Mtg Bkt	59p
BY85G	3800 Rear Panel	£4.56
XQ04E	3800 Cabinet	£49.60
	Carr in UK with XQ04	£9.00
YQ46A	Synth Demo Tape	£4.50
XF41U	Synth Guide Book	£2.00NV
XF42V	5600S Patch Chart	7pNV
XF43W	3800 Patch Chart	7pNV
XF10L	ETI Top Project No.5	£1.25NV
BB76H	Touch Organ PCB	£5.99

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XH18U	MES22	25pNV
BY78K	Piano PSU/Voice PCB	£4.45
BY79L	Piano Top Oct PCB	£4.95
BY80B	Piano Two-Oct PCB	£5.55
XF03D	MES26	£1.20NV
BB28F	RC Coder PCB	£1.95
BB29G	RC Xmitter PCB	£1.92
BB30H	RC Receiver PCB	£1.45
BB31J	RC Interface PCB	£1.55
BB32K	RC Decoder PCB	£1.35
BB33L	RC Relay Drive PCB	94p
BB34M	RC Servo Drive PCB	82p
BB35Q	RC Servo Amp PCB	92p
BB36P	RC Tone Gen PCB	85p
BB37S	RC Tone Decoder PCB	85p
YQ03D	McM Encoder PCB	£1.10
YQ04E	McM Receiver PCB	£1.18
YQ05F	McM Rcvr Dcdr PCB	£1.05
YQ07H	McM Transmitter PCB	£1.95
YQ06G	McM Stereophoner PCB	£1.10
XQ06G	Piano Cabinet Black	£49.95■
XY11M	Piano Cabinet Teak	£63.63
YQ08J	McM Elect Ig/Cnv PCB	£1.60
YQ09K	McM Flasher PCB	£1.10

1981 Catalogue Page No.		VAT inclusive PRICE
YQ19V	LM380 Amp PCB	£1.25
YQ20W	20W Amp PCB	£1.50
YQ18U	Tone Con PCB	£1.55
YQ21X	Snd/Light Conv PCB	£2.10
Page 156		
XH20W	MES25	25p*NV*
BB16S	Orgn/Gtar Bass PCB	£10.50
XH19V	MES49	DIS
XL13P	Drumsette Kit	DIS
XX16S	Drumsette 1 PCB	DIS
XX17T	Drumsette 2 PCB	DIS
LY01B	Drumsette Fmt Panel	DIS
LY02C	Drumsette Rear Panel	DIS
HY02C	Drumsette Bkt Set	DIS
XB98G	Drumsette Cabinet	DIS
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XH48C	MES33	40p*NV*
FL94C	HiFi Amp Sel Mthr PC	£4.20
FL95D	HiFi Amp Sel PCB	£3.25
FL96E	HiFi Amp Eql Mthr PC	£2.95
FL97F	HiFi Amp Eql PCB	£1.97
FL98G	HiFi Amp Pk Det PCB	95p
FL99H	HiFi Amp PSU PCB	£1.65
XX32K	H/Phones Skt Brckt	59p
XY21X	HiFi Amp Chassis	£18.93
XY22Y	HiFi Amp Screen	£1.85
XY23A	HiFi Amp Frt Panel	£8.30
XY24B	HiFi Amp Cover Black	£6.95
Page 158		
LW40T	Tuner Metalwork Kit	£42.88
LW41U	Tuner PSU Module	£23.95
LW42V	Tuner Switching Mod	£18.95
Page 159		
LW45Y	TV Sound Tuner	£39.55
LW44X	Tuner Head EF5600U	£23.79
LW43W	Tuner IF Module	£18.98
LW46A	AM Tuner	£17.95
LW48C	Stereo Tuner Kit	£161.00
YQ00A	IF Tuner Mono Module	£9.50
YQ10L	12/30V PSU Module	£6.70
Page 160		
XH07H	MES32	DIS
BB55K	Dyn Noise Filter PCB	£2.20
XB05F	Dyn Noise Fltr Mwrk	DIS
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XH21X	MES37	25p*NV*
XX03D	10-Channel G.E. PCB	£1.95
XB74R	10-Chl Eqlsr Mtwrk	£10.45
XB75S	10-Chl Eqlsr Wwrk	£5.50
HY21X	Clock Timer PCB	DIS
†LW30H	Clock Timer Case	£12.90
LW31J	Clock Timer Kit	£43.57
XY32K	Cassette Mechanism	£14.95
XY34M	Stereo Tape Module	£19.73
YQ30H	Tape Switch Board	42p
YQ33L	Tape Switch Bracket	51p
YQ31J	Tape PSU PCB	39p
XY35Q	Cassette Parts Kit	£12.98
XY36P	Cassette Recrder Kit	£39.95
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XF04E	MES41	40p*NV*
XB76H	Disco Front Panel	£11.50
BB26D	Motor Switch PCB	£1.15
BB27E	Light Mod Bd	£4.85
BB18U	Heatsink DR2	74p
XB77J	Disco Cabinet	£48.44
	Carr in UK with XB77	£8.00
BB81C	Disco Pre-Amp Tn PCB	£4.45
BB19V	Disco PSU PCB	£1.95
BB20W	100W Amp Board	£2.35
XY26D	Heatsink Mtg Plate	£3.95
XY27E	Heatsink Cover	£6.45
BB22Y	FET-Ceramic PU Bd	£1.65
BB24B	Disco Fader Bd	£1.95
BB25C	VUM & HP Amp Bd	£2.35
XH23A	MES42	25p*NV*
XB37S	Sound To Light Case	£11.50
Page 164		
LR13P	HQ Mixer PCB No.2	£1.96
LR14Q	HQ Mixer PCB No.3	£1.55
LR15R	HQ Mixer PCB No.4	£1.35
LR34M	HQ Mixer PCB No.24	£1.98
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LR16S	HQ Mixer PCB No.5	£1.10
LR35Q	HQ Mixer PCB No.25	£1.60
LR21X	HQ Mixer PCB No.6	88p
LR22Y	HQ Mixer PCB No.7	£1.75
LR23A	HQ Mixer PCB No.8	£1.60
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LR24B	HQ Mixer PCB No.9	99p
LR42V	HQ Mixer PCB No. 29	£1.98
LR25C	HQ Mixer PCB No.10	£1.85
LR26D	HQ Mixer PCB No.14	£1.87
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LW35Q	50W Amp Kit	£14.95
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HQ68Y	50W Hi-Fi PCB	£2.85
LW32K	150W Power Amp Kit	£17.95
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BY74R	Michron MkII PCB	DIS
†YB92A	Michron MkII Case	£6.81
LW37S	Michron MkII Clk Kit	DIS
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XL07H	MA1003	DIS
YL19V	L.C.Clock Module	£13.40
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LW39N	Burglar Alarm Kit	DIS
LW38R	Ultrasonic Dtctr Kit	DIS

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XH49D	MES47	DIS
YQ52G	Ultrason Tx PCB	DIS
YQ53H	Ultrasonic Rx PCB	DIS
BY92A	Burglar Alarm PCB	DIS
BY93B	External Alarm PCB	DIS
BY95D	Alarm Box Bracket	DIS
XY14Q	External Alarm Box	£12.80
XY13P	Burglar Alarm Box	DIS
BB72P	Sine/Square Gen PCB	£2.95
BB73Q	Audio Osc Frt Panel	£1.74
XH24B	MES15	15p*NV*
XH27E	MES16	15p*NV*
XX40T	Ignition PCB	£1.30
XX41U	Ign Mtg Plate	£1.28
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XH26D	MES71	30p*NV*
BB82D	Keyboard PCB	£7.35
BB83E	VDU Logic PCB	£9.50
BB98G	VDU PSU PCB	£2.98
XY12N	VDU Front Panel	£7.90
XX05F	UHF Mod No 2	£4.99
XF44X	Magnum Booklet	50p*NV*
YQ44X	Magnum 1 PCB	£2.95
YQ45Y	Magnum 2 PCB	£2.95
PROTECTION		
Page 175		
RX96E	Safuseholder 20	45p
RX97F	Safuseholder 1.1/4in	75p
RX49D	Chassis F/H 20mm	11p
RX50E	Chassis F/H 1.1/4 in	17p
WH49D	Fuse Clip	3p
RX51F	F/H Car	10p
WR93R	Fuse 20mm 50mA	6p
WR00A	Fuse 20mm 100mA	6p
WR94C	Fuse 20mm 150mA	6p
WR01B	Fuse 20mm 250mA	6p
WR02C	Fuse 20mm 500mA	6p
WR03D	Fuse 20mm 1A	8p
WR04E	Fuse 20mm 1.5A	8p
WR05F	Fuse 20mm 2A	8p
WR06G	Fuse 20mm 3A	8p
WR07H	Fuse 20mm 5A	7p
WR18U	Fuse A/S 500mA	12p
WR19V	Fuse A/S 1A	12p
WR20W	Fuse A/S 2A	12p
WR95D	Fuse 1.1/4 50mA	4p
WR08J	Fuse 1.1/4 100mA	6p
WR96E	Fuse 1.1/4 150mA	8p
WR09K	Fuse 1.1/4 250mA	7p
WR10L	Fuse 1.1/4 500mA	6p
WR11M	Fuse 1.1/4 1A	8p
WR12N	Fuse 1.1/4 1.5A	8p
WR13P	Fuse 1.1/4 2A	8p
WR14Q	Fuse 1.1/4 3A	8p
WR15R	Fuse 1.1/4 5A	9p
WR16S	Fuse 1.1/4 10A	8p
WR17T	Fuse 1.1/4 15A	12p
HQ31J	Plug Fuse 2A	15p
HQ32K	Plug Fuse 3A	14p
HQ33L	Plug Fuse 5A	15p
HQ34M	Plug Fuse 13A	14p
HB51F	Fuse Wire	30p
HW04E	RF Supp Choke 1A	29p
HW05F	RF Supp Choke 2A	29p
HW06G	RF Supp Choke 3A	39p
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HW13P	Mains Trans Supp	65p
HW07H	Delta Cap	97p
YR90X	R-C Network	£1.39
YW46A	Door Contact Reed	£1.49
YW50E	Window Foil	£1.25
YW51F	Foil Terms	65p
YW47B	Surface BA Reed	£1.95
YW48C	Door Loop	£1.75
YW49D	BA Junction Box	59p
YB91Y	Pressure Mat	£3.55
XY33L	Smoke Detectr Type 1	£12.75
RECORD AND TAPE		
Page 177		
XQ00A	Autochanger	£22.50
XB23A	Rim Drive Turntable	£29.90
*XB25C	Belt Drive Turntable	£34.50
Page 178		
FQ17T	Cartridge Slide MP60	£2.68
FQ18U	Cartridge Slide 710	DIS
FQ19V	Crtridge Slide BDS95	DIS
LB75S	Drive Wheel BSR	£1.55
FQ20W	Spindle Auto BSR	£4.40■
FQ21X	Spindle Manual BSR	56p
YW58N	BSR Drive Belt	£2.20
FQ22Y	Carrier Kit SL75K	£4.85
FQ23A	Cartrdg Carrier SL95	£3.95
FQ24B	Carrier Kit SL95K	£5.25
FQ25C	Crtrdg Car Zero 100	£4.45
FQ26D	Cartrdg Car SP25II	£4.45
FQ28F	Cartrdg Crrier SP25V	£4.25
FQ29G	Carrier Kit SP25VK	£5.95
LB76H	Dr Wheel Garrard Lrg	£2.55
FQ30H	Dr Wheel Garrard Sm	£2.85
FQ31J	Spindle Man Short	72p
FQ32K	Spindle Man Long	79p
FQ33L	Spindle Auto Short	£4.50
FQ34M	Spindle Auto Long	£4.85
YB43W	SP25IV Tone Arm	DIS
FQ35Q	CB Weight SP25IV	£3.95
FQ36P	Garrard Drive Belt	£2.50
YB44X	SP25III Motor	DIS
YB45Y	SP25IV Motor	DIS
Page 179		
XX34M	Headshell	£3.50
HR01B	Ctrdg BSR X5M	£3.65
HR02C	Ctrdg BSR X5H	£3.65
HR04E	Ctrdg BSR SX6M	£4.25
HR05F	Ctrdg BSR SX6H	£4.25
YX76H	Drive Belt 46mm	98p
YX77J	Drive Belt 57mm	98p
YX78K	Drive Belt 66mm	98p
YX79L	Drive Belt 76mm	98p
YX80B	Drive Belt 90mm	98p
HR06G	Ctrdg Acos 104	DIS
HR09K	Ctrdg BSR SC12M	£3.75
HR10L	Ctrdg BSR SC12H	£3.65
YX83E	Ctridge Philips GP215	£4.55
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FY75S	Ctrdg Rigonda 2SB	£4.45

1981 Catalogue Page No.		VAT inclusive PRICE
HR11M	Ctrdg Sono 9TAHC	£5.93
HR12N	Ctrdg Sono 3509	£4.95
HR13P	Ctrdg Sono 3549	£5.95
HR14Q	Ctrdg Sono 3559	£5.25
HR17T	Ctrdg Sono V100	£5.98
YX81C	Cartridge QLM30	£9.55
YX82D	Cartridge QLM36	£21.40
HR15R	Ctrdg Goldring G850	£5.70
HR16S	Ctrdg Goldring G800	£7.40
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FQ38R	Ctrdg Goldring G800H	£14.25
FQ39N	Ctrdg Goldring G800E	£11.95
FQ40T	Ctrdg Tenorel T2001D	£4.85
FQ41U	Cdg Tenorel T2001ED	£9.95
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HR25C	Stylus GP91SC DD	£1.85
HR28F	Stylus GP93 DD	£1.85
HR65V	Stylus GP95 DD	£1.85
HR31J	Stylus GP104 DD	£1.85
HR66W	Stylus Acos SM6	£4.95
YX05F	Stylus ADCRK8	£5.82■
YX06G	Stylus ADC RSQ30	£7.07■
YX07H	Stylus ADC RSQ36	£16.35
YX08J	Stylus AT6	£4.95
YX09K	Stylus AT70	£4.95
YX10L	Stylus ATS11E	£5.50■
HR68Y	Stylus VM8	£5.50
HR39N	Stylus BSR TC8 D	£1.50
HR71N	Stylus BSR ST4 DD	£1.85
HR42V	Stylus BSR ST10	£1.85
HR45Y	Stylus BSR ST15	£1.85
HR47B	Stylus BSR ST17 DD	£1.85
HR74R	Stylus BSR ST21	£1.85
HR75S	Stylus Decca Deram	£1.50■
YX11M	Stylus Dual DN201	£5.50
YX12N	Stylus Garrard GA150	£10.50
HR76H	Stylus D110E	£5.50
HR77J	Stylus D110H	£2.95
HR48C	Stylus D110SR	£1.95
HR49D	Stylus D120SR	£2.45
HR78K	Stylus Hitachi ST101	£4.95
HR79L	Stylus Hitachi ST103	£6.75
YX13P	Stylus Hitachi ST104	£4.95
*YX14Q	Stylus JVC DT21S	£4.35
FQ54J	Stylus Victor DT33	£4.95
*YX15R	Stylus JVC DT36	£4.35
HR81C	Stylus LV65977D	£1.50
HR83E	Stylus NP EPS36	£2.25
HR84F	Stylus NP EPS52	£4.95
YX16S	Stylus NP EPS53	£5.50
YX17T	Stylus Philip AG3306	£1.85
HR87U	Sty Philips GP200DD	£1.85
HR89W	Stylus Philips GP205	£1.25
YX18U	Stylus Philips GP213	£1.85
HR90X	Styl Philips GP400	£4.35
YX19V	Styl Philps GP400Mk2	£4.95
YX20W	Styl Philps GP401Mk2	£6.75
Page 183		
HR93B	Stylus RIG-2SB DD	£1.85
HR51F	Stylus BF40D	£1.85
HR96E	Stylus DM500/7	£4.95
YX22Y	Stylus Sanyo ST10J	£4.95
HR95D	Stylus Sansui	£4.95
YX23A	Stylus Sansui SN41	£4.95
YX24B	Stylus Sanyo ST7D	£4.95
HR97F	Stylus Sanyo 2611	£4.95
FQ48C	Stylus Sony ND128	£2.20
YX25C	Stylus Sharp 101	£4.95
HR98G	Stylus Sharp 706	£4.95
HR99H	Stylus Sharp 717	£4.95
HR60Q	Stylus 9TAHC DD	£1.85
HR61R	Stylus Sonotone V100	£4.95
YX26D	Stylus Sonotone V101	£4.95
FQ45Y	Stylus 2509	£1.85
FQ43W	Stylus 2529 DD	£1.85
HR53H	Stylus KS40A DD	£1.85
HR55K	Stylus KS41B DD	£1.85
HR57M	Stylus KS41C DD	£1.85
YX27E	Stylus Sony XL15	£4.35
YX28F	Stylus Sony ND126	£4.95
FQ49D	Stylus Sony ND133	£5.50
FQ50E	Stylus Sony ND134	£5.50
FQ51F	Styl Tenorel N2001D	£2.95
YX29G	Styl Tenorel N2001DM	£2.95
FQ52G	Styl Tenorel N2001ED	£6.75■
YX30H	Stylus Tetrad 51	£2.25
FQ53H	Stylus Toshiba N3C	£2.20
YX31J	Stylus Toshiba N55	£4.95
YX32K	Stylus Toshiba N58	£4.95
YX21X	Stylus Toshiba N550	£4.95
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YB47B	Record Care kt C106	£4.95
*LX03D	Musicentre Kit C113	£6.45
LX06G	Cleaning Arm C100	£3.25
LH89W	Cleaning Arm C108	£4.95
FR44X	Roller Pack C93	35p
YW80B	Roller Pack C96	48p
YW81C	Cleaning Cloth C104	78p
FR48C	Dust-Off C101	99p
YW82D	Cleaner C92	£4.65
YX93B	Stylus Microscope	£2.45
YW83E	Stylus Brush C103	12p
YW84F	Stylus Brush C97	28p
FR46A	Stylus Cleaner C95	80p
YB55K	Cleaning Kit C116	£2.42
Page 185		
FR52G	Anti-Stat Fluid 69S	49p
LX10L	Anti-Stat Mat C119	£1.95
LX04E	Anti-Stat Gun	£5.25
FQ60Q	Spirit Level 44	£3.65
FR49D	Stylus Balance PX1	£2.45
YW85G	Record Grip C206	£1.28
FR50E	Gram Speed Indicator	9p
YW86T	Cassette Kit C115	£1.85
YB56L	Cassette Kit C107	£4.25
RB04E	Cass Head Clnr C118	£1.25
YW87U	Cleaning Stick C109	23p
YW88V	Tape Cleaning Fluid	58p
Page 186		
FR54J	Cassette Clnr Tape	55p
YW89W	Cassette Cln & Demag	£2.25
FR62S	Straight Demagnetzer	£3.35
FQ62S	Curved Demagnetiser	£3.85
*YW90X	Cassette Splicer	£4.25
YW91Y	Splicing Block	£1.85

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LX17T	Splicing Tape	65p
RB03D	Cassette Case	23p
FR60Q	Index Cards	£1.40
RB01B	Cassette Fast Winder	£2.75
FR59P	Test Cassette 53	£4.98
YG25C	Cassette Tape C60	61p
YG26D	Cassette Tape C90	65p
Page 187		
RB05F	Cassette Tray 52A	£1.87
RB07H	Rota-Rack	£2.45
LH91Y	Cassettebox	£4.65
LH92A	Videocassettebox	£9.68
FQ63T	GF Cassette Head	£12.80
FQ64U	Mono Cassette Head	£4.55
FQ66W	Cassette Erase Head	£2.55
FQ65V	Stereo Cassette Head	£4.75
FQ67X	Tape Hd Two-Track RP	£15.50
Page 188		
FQ68Y	Tpe Hd Two-Trck Eras	£9.95
FQ69A	Tape hd Four-Trck RP	£15.25
FQ70M	Tpe Hd Four Trk Eras	£8.85
FQ71N	2-Head Bracket	£4.65
FQ72P	3-Head Bracket	£5.39
RESISTORS		
Page 189		
U	Micro Res	3p
M	Min Res	2p
S	Std Res	3p
C	1W Res	5p
Page 190		
X	Oxide	5p
T	1% Res	9p
XL05F	Colour Wheel	25p
W	W/W Min Res	19p
Page 191		
L	7W W/W	24p
H	10W W/W	29p
P	25 W/W Res	£1.65
V	HV Res 1M-33M	12p■
V	HV Res 47M	22p
BL64U	Constantan 28 swg	£3.35
YY12N	Resnet 100R	85p
YY13P	Resnet 220R	85p
YY14Q	Resnet 470R	85p
YY15R	Resnet 1k	85p
YY16S	Resnet 2k2	85p
YY17T	Resnet 4k7	85p
YY18U	Resnet 10k	85p
YY19V	Resnet 22k	85p
YY20W	Resnet 47k	85p
YY21X	Resnet 100k	85p
WR52G	Hor S-Min Prest 100R	10p
WR53H	Hor S-Min Prest 220R	10p
WR54J	Hor S-Min Prest 470R	10p
WR55K	Hor S-Min Prest 1k	10p
WR56L	Hor S-Min Prest 2K2	10p
WR57M	Hor S-Min Prest 4k7	10p
WR58N	Hor S-Min Prest 10k	10p
WR59P	Hor S-Min Prest 22K	10p
WR60Q	Hor S-Min Prest 47k	10p
WR61R	Hor S-Min 100k	10p
WR62S	Hor S-Min Prest 220k	10p
WR63T	Hor S-Min Prest 470k	10p
WR64U	Hor S-Min Preset 1M	10p
WR65V	Vrt S-Min Prest 100R	11p
WR66W	Vrt S-Min Prest 220R	11p
WR67X	Vrt S-Min Prest 470R	11p
WR68Y	Vrt S-Min Prest 1k	11p
WR69A	Vrt S-Min Prest 2k2	11p
WR70M	Vrt S-Min Prest 4k7	11p
WR71N	Vrt S-Min Prest 10k	11p
WR72P	Vrt S-Min Prest 22k	11p
WR73Q	Vrt S-Min Prest 47k	11p
WR74R	Vrt S-Min Prest 100k	11p
WR75S	Vrt S-Min Prest 220k	11p
WR76H	Vrt S-Min Prest 470k	11p
WR77J	Vert S-Min Prest 1M	11p
Page 192		
WR78K	Hor Skeleton 100R	14p
WR79L	Hor Skeleton 220R	14p
WR80B	Hor Skeleton 470R	26p
WR81C	Hor Skeleton 1k	26p
WR82D	Hor Skeleton 2k2	26p
WR83E	Hor Skeleton 4k7	26p
WR84F	Hor Skelton 10k	26p
WR85G	Hor Skeleton 22k	26p
WR86T	Hor Skeleton 47k	26p
WR87U	Hor Skeleton 100k	26p
WR88V	Hor Skeleton 220k	26p
WR89W	Hor Skeleton 470k	26p
WR90X	Hor Skeleton 1M	26p
WR91Y	Hor Skeleton 2M2	26p
WR92A	Hor Skeleton 4M7	26p
WW00A	Vrt Skeleton 100R	24p
WW01B	Vrt Skeleton 220R	24p
WW02C	Vert Skeleton 470R	24p
WW03D	Vrt Skeleton 1k	24p
WW04E	Vrt Skeleton 2k2	24p
WW05F	Vrt Skeleton 4k7	24p
WW06G	Vrt Skeleton 10k	24p
WW07H	Vrt Skeleton 22k	24p
WW08J	Vrt Skeleton 47k	24p
WW09K	Vrt Skeleton 100k	24p
WW10L	Vrt Skeleton 220k	24p
WW11M	Vrt Skeleton 470k	24p
WW12N	Vrt Skeleton 1M	28p
WW13P	Vrt Skeleton 2M2	24p
WW14Q	Vrt Skeleton 4M7	24p
WR38R	Cermet 100R	98p
WR39N	Cermet 500R	98p
WR40T	Cermet 1k	98p
WR41U	Cermet 5k	98p
WR42V	Cermet 10k	98p
WR43W	Cermet 50k	98p
WR44X	Cermet 100k	98p
WR45Y	Cermet 1M	98p
WR46A	15-Turn Cermet 500R	£1.20
WR47B	15-Turn Cermet 1k	£1.20
WR48C	15-Turn Cermet 5k	£1.20
WR49D	15-Turn Cermet 10k	£1.20
WR50E	15-Turn Cermet 50k	£1.20
WR51F	15-Turn Cermet 100k	£1.20
BW06G	Edge Control Pot	65p
BW07H	Edge Knob Small Blk	8p
BW08J	Edge Knob Small Grey	8p
BW09K	Edge Knob Large Blk	8p
BW10L	Edge Knob Large Grey	8p
FW00A	Pot Lin 1k	37p

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FW01B	Pot Lin 4k7	37p
FW02C	Pot Lin 10k	37p
FW03D	Pot Lin 22k	37p
FW04E	Pot Lin 47k	37p
FW05F	Pot Lin 100k	37p
FW06G	Pot Lin 220k	37p
FW07H	Pot Lin 470k	37p
FW08J	Pot Lin 1M	37p
FW09K	Pot Lin 2M2	37p
FW21X	Pot Log 4k7	37p
FW22Y	Pot Log 10k	37p
FW23A	Pot Log 22k	37p
FW24B	Pot Log 47k	37p
FW25C	Pot Log 100k	37p
FW26D	Pot Log 220k	37p
FW27E	Pot Log 470k	37p
FW28F	Pot Log 1M	37p
FW29G	Pot Log 2M2	37p
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FW41U	Sw Pot Lin 4k7	95p
FW42V	Sw Pot Lin 10k	95p
FW43W	Sw Pot Lin 22k	95p
FW44X	Sw Pot Lin 47k	95p
FW45Y	Sw Pot Lin 100k	95p
FW46A	Sw Pot Lin 220k	95p
FW47B	Sw Pot Lin 470k	95p
FW48C	Sw Pot Lin 1M	95p
FW49D	Sw Pot Lin 2M2	95p
FW62S	Sw Pot Log 4k7	95p
FW63T	Sw Pot Log 10k	95p
FW64U	Sw Pot Log 22k	95p
FW65V	Sw Pot Log 47k	95p
FW66W	Sw Pot Log 100k	95p
FW67X	Sw Pot Log 220k	95p
FW68Y	Sw Pot Log 470k	95p
FW69A	Sw Pot Log 1M	95p
FW70M	Sw Pot Log 2M2	95p
FW50E	W/W Pot 10R	£2.15
FW51F	W/W Pot 20R	£1.99
FW52G	W/W Pot 50R	£1.99■
FW71N	W/W Pot 100R	£2.55
FW72P	W/W Pot 200R	£1.98
FW73Q	W/W Pot 500R	£1.85
FW93B	W/W Pot 1k	£1.85
FW96E	W/W Pot 2k	59p
FW94C	W/W Pot 5k	99p
FW95D	W/W Pot 10k	£2.29
FX18U	W/W Pot 50k	£2.79
FW84F	Dual Pot Lin 4k7	99p
FW85G	Dual Pot Lin 10k	99p
FW86T	Dual Pot Lin 22k	99p
FW87U	Dual Pot Lin 47k	99p
FW88V	Dual Pot Lin 100k	99p
FW89W	Dual Pot Lin 220k	99p
FW90X	Dual Pot Lin 470k	99p
FW91Y	Dual Pot Lin 1M	99p
FW92A	Dual Pot Lin 2M2	99p
FX08J	Dual Pot Log 4k7	£1.10
FX09K	Dual Pot Log 10k	£1.10
FX10L	Dual Pot Log 22k	£1.10
FX11M	Dual Pot Log 47k	£1.10
FX12N	Dual Pot Log 100k	£1.10
FX13P	Dual Pot Log 220k	£1.10
FX14Q	Dual Pot Log 470k	£1.10
FX15R	Dual Pot Log 1M	£1.10
FX16S	Dual Pot Log 2M2	£1.10
FX40T	L/S Control 20R	55p
FX97F	L/S Control 50R	55p
FX98G	L/S Control 100R	55p
FX99H	L/S Control 200R	55p
YG04E	Rheostat 50R	£4.90
YG05F	Rheostat 100R	£4.90
YG06G	Rheostat 150R	£4.90
YG07H	Rheostat 200R	£4.90
Page 194		
FX32K	Slide Pot Lin 5k	79p
FX33L	Slide Pot Lin 10k	79p
FX34M	Slide Pot Lin 25k	79p
FX35Q	Slide Pot Lin 50k	79p
FX36P	Slide Pot Lin 100k	79p
FX37S	Slide Pot Lin 250k	79p
FX38R	Slide Pot Lin 500k	79p
FX53H	Slide Pot Log 5k	79p
FX54J	Slide Pot Log 10k	79p
FX55K	Slide Pot Log 25k	79p
FX56L	Slide Pot Log 50k	79p
FX57M	Slide Pot Log 100k	79p
FX58N	Slide Pot Log 250k	79p
FX59P	Slide Pot Log 500k	79p
FX76H	Dual Slide Lin 5k	£1.25
FX77J	Dual Slide Lin 10k	£1.25
FX80B	Dual Slide Lin 100k	£1.25
HB02C	Dual Slide Log 10k	£1.25
HB04E	Dual Slide Log 50k	£1.25
HB05F	Dual Slide Log 100k	£1.25
HB07H	Dual Slide Log 500k	£1.25
FX07H	Slide Bezel	49p
XB09K	Joystick Pot	£6.38
XB06G	Joystick Mtg Plate	£1.66
HQ50E	2-Axis Joystick	£3.25
Page 195		
FX21X	Thermistor VA1055S	49p
FX22Y	Thermistor VA1056S	38p
FX42V	Thermistor VA1066S	41p
FX43W	Thermistor VA1067S	39p
FX62S	Thermistor R53	£5.95
WH23A	Thermistor G16	£5.40
WH24B	Thermistor G23	£5.35
HB10L	LDR ORP12	£1.35
HB11M	LDR ORP60	£1.72
HB12N	LDR ORP61	DIS
HB09K	LDR RPY58A	£1.07
SEMICONDUCTORS		
Page 196		
QB00A	AA119	11p
QB01B	AC126	36p
QB02C	AC127	38p
QB03D	AC128	42p
QB04E	AC141	37p
QB05F	AC142	33p
QB06G	AC176	26p
QB07H	AC187	29p
QB08J	AC188	37p
QB10L	ACY19	77p
QB11M	ACY20	75p
QB12N	ACY21	DIS
BL30H	AD140	£1.55
BL31J	AD149	£1.35
BL32K	AD161	61p
BL33L	AD161/2MP	£1.32
BL34M	AD162	62p

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QQ00A	ADC0804LCN	£4.45
QB19V	AF139	65p
QB20W	AF239	88p
BR45Y	AS314	33p
QB21X	AY-1-0212	£8.20
HQ52G	AY-1-1320	£4.99
HQ51F	AY-1-5050	£1.99
YY98G	AY-3-1270	£8.30
YY99W	AY-3-1350	£5.95■
WQ17T	AY-3-8115	DIS
WQ18U	AY-5-1013A	£5.98
QB24B	AY-5-1224	DIS
QB25C	AY-5-1230	£5.27
WQ19V	AY-5-2376	£9.95
QB26D	AY-5-4007D	£6.90
QB27E	BA102B	29p
QQ12N	BA243	10p
QQ13P	BAR28	15p
QB28F	BAX13	7p
QB29G	BAX16	7p
QB30H	BB110G	DIS
QB31J	BC107B	14p
QB32K	BC108C	14p
QB33L	BC109C	16p
QB34M	BC117	24p
QB35Q	BC119	39p
QB36P	BC139	40p
QB37S	BC140	34p
QB38R	BC141	37p
QB39N	BC142	34p
QB40T	BC143	34p
QB44X	BC154	27p
QB48C	BC160	43p
QB49D	BC161	36p
QB50E	BC168C	11p
QB51F	BC169C	11p
QB52G	BC177	20p
QB53H	BC178	20p
QB54J	BC179	20p
QB55K	BC182L	11p
QB56L	BC183L	11p
QB57M	BC184L	11p
QB58N	BC204	15p
QB59P	BC209C	14p
QB60Q	BC212L	11p
QB61R	BC213L	11p
QB62S	BC214L	10p
QB63T	BC301/5	40p
QB64U	BC301/5/302/5MP	89p
QB65V	BC302/5	36p
QB66W	BC327	15p
QB67X	BC328	15p
QB68Y	BC337	15p
QB69A	BC338	15p
QB70M	BC441	38p
QB71N	BC441/461MP	79p■
QB72P	BC461	43p
QQ14Q	BC547	11p
QB73Q	BC548	14p
QQ15R	BC549	12p
QQ16S	BC557	11p
QQ17T	BC558	11p
QQ18U	BC559	11p
QB74R	BC650	29p
QF00A	BCY70	18p
QF01B	BCY71	18p
QF03D	BD131	49p
QF04E	BD131/2MP	£1.19
QF05F	BD132	50p
QF06G	BD135	45p
QF75S	BD136	40p
QF07H	BD139	40p
QF08J	BD140	40p
WH15R	BD711	68p
WH16S	BD712	68p
QF09K	BF115	38p
QF10L	BF167	38p
QF11M	BF180	45p
QF15R	BF200	32p
QF16S	BF244	30p
QF17T	BF258	33p
QF18U	BF259	39p
QF19V	BF337	40p
QQ19V	BF494	25p
QQ20W	BF495	25p
QF20W	BFW10	£1.43
QF21X	BFX29	33p
QF22Y	BFX30	35p
QF23A	BFX84	34p
QF24B	BFX85	31p
QF25C	BFX87	32p
QF26D	BFX88	36p
QF27E	BFY50	30p
QF28F	BFY51	29p
QF29G	BFY52	31p
QF30H	BPX25	£2.70
QF31J	BRY39	42p
QF32K	BSX20	26p
QF33L	BSX21	29p
QF34M	BSY95A	26p
QF35Q	BT109	£1.49
QF37S	BU205	£1.90
QF38R	BU206	DIS
QF39N	BU208	£2.99
QF41U	BY126	21p
QF42V	BY127	13p
QF43W	BY164	76p
QF44X	BY206	30p
QF45Y	BZX61C4V7	16p■
QF46A	BZX61C5V1	16p■
QF47B	BZX61C5V6	16p■
QF48C	BZX61C6V2	16p■
QF49D	BZX61C6V8	16p■
QF50E	BZX61C7V5	16p■
QF51F	BZX61C8V2	16p■
QF52G	BZX61C9V1	16p■
QF53H	BZX61C10	16p■
QF54J	BZX61C11	16p■
QF55K	BZX61C12	16p■
QF56L	BZX61C13	16p■
QF57M	BZX61C15	16p■
QF58N	BZX61C16	16p■
QF59P	BZX61C18	16p■
QF60Q	BZX61C20	16p■
QF61R	BZX61C22	16p■
QF62S	BZX61C24	16p■
QF63T	BZX61C27	16p■
QF64U	BZX61C30	16p■
QF65V	BZX61C33	16p■
QF66W	BZX61C36	16p■
QF67X	BZX61C39	16p■
QF68Y	BZX61C43	16p■
QF69A	BZX61C47	16p■
QF70M	BZX61C51	16p■
QF71N	BZX61C56	16p■
QF72P	BZX61C62	16p■
QF73Q	BZX61C68	16p■
QF74R	BZX61C75	16p■
QH00A	BZY88C2V7	9p
QH01B	BZY88C3V0	9p
QH02C	BZY88C3V3	9p
QH03D	BZY88C3V6	9p
QH04E	BZY88C3V9	9p
QH05F	BZY88C4V3	9p
QH06G	BZY88C4V7	9p
QH07H	BZY88C5V1	9p
QH08J	BZY88C5V6	9p
QH09K	BZY88C6V2	9p
QH10L	BZY88C6V8	9p
QH11M	BZY88C7V5	8p
QH12N	BZY88C8V2	9p
QH13P	BZY88C9V1	9p
QH14Q	BZY88C10	9p
QH15R	BZY88C11	9p
QH16S	BZY88C12	9p
QH17T	BZY88C13	9p
QH18U	BZY88C15	9p
QH19V	BZY88C16	9p
QH20W	BZY88C18	9p
QH21X	BZY88C20	9p
QH22Y	BZY88C22	9p
QH23A	BZY88C24	9p
QH24B	BZY88C27	8p■
QH25C	BZY88C30	9p
QH26D	CA3046	72p■
YH58N	CA3080E	87p■
QH27E	CA3089E	£2.70
QH28F	CA3130T	£1.10■
QH29G	CA3140T	99p
WQ20W	CA3189E	£1.95
WQ21X	CA3240E	£1.38
YG37S	CL8960	£29.95
QH30H	C106D	42p
WQ22Y	C116D	99p
WQ23A	C126D	£1.63
WQ24B	C206D	95p■
WQ25C	C226D	64p■
QL14Q	C246D	£1.24
QQ01B	DAC0801LCN	£2.45
YY82D	DF412	£6.45
QQ21X	DV1202W	£8.35
QQ22Y	DV1205W	£10.70
QQ23A	DV1210W	£13.63
QQ24B	DV1220W	£16.88
QQ25C	DV1230W	£21.30
QQ26D	DV1240W	£25.50
WQ26D	ER1400	£9.99
WQ27E	ER3401	DIS
WQ28F	HSCH1001	55p
YH59P	ICL7109	£16.55
YY75S	ICL7660CPA	£3.24
YY93B	ICM7045IPI	£14.20■
YY94C	ICM7216DIPI	£17.45
YY95D	ICM7226BIPI	£21.90
YH63T	ICM 7555	£1.25
QH32K	IR122A	DIS
QH33L	IR122D	£3.95
BH45Y	J005	£1.75
BL36P	J02	£1.80
BH46A	J04	£1.95
BH47B	K01	£3.15
BH48C	K04	£4.25
*YY74R	L200	£2.69
WQ29G	LF347	£2.55
WQ30H	LF351	56p
WQ31J	LF353	99p
YY69A	LF13741	55p
QH35Q	LH0042C	£4.30■
QH36P	LM301A	27p
QH37S	LM308	95p
WQ32K	LM334	£1.10
YY73Q	LM335Z	£1.23
QH38R	LM377	£1.77
QH39N	LM379S	£5.29
QH40T	LM380	75p
QH41U	LM381	£1.57■
YY84F	LM382	£1.31■
*WQ33L	LM383	£1.61
WQ34M	LM384	£1.44
WQ35Q	LM387	£1.25
WQ36P	LM389	£1.49
YY85G	LM1818	£1.95
YY99H	LM1830	£2.65
YY71N	LM1871	£5.60
YY72P	LM1872	£5.90
WQ38R	LM2917	£2.29
WQ37S	LM1820	£1.80
QH42V	LM3900	57p
WQ39N	LM3909	87p■
*WQ40T	LM3911	£1.31
WQ41U	LM3914	£2.41
YY96E	LM3915	£2.93
YY97F	LM3916	£3.46
YH64U	LM13600N	£1.39
YY81C	M083	£4.75
WH22Y	M087	£4.95
YY90X	M108	£18.25
YY91Y	M147	£6.51
HQ71N	M251	£12.20
†QH64U	M252	£8.95
WH21X	M254	£7.49
XL07H	MA1003	DIS
XL14Q	MA1023	DIS
QH43W	MCR102	59p
QH44X	MC1303	DIS
QH45Y	MC1310P	£2.30
QH47B	MC1496	89p
QH48C	MC3302P	80p
QH49D	MC3340P	£1.35
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QH50E	MC3360P	DIS
WQ42V	MCM4027 250ns	£1.88
WQ43W	MC6800P	£5.10
WQ44X	MC6802P	£5.99
WQ45Y	MC6810AP 450ns	£1.98
WQ46A	MC6821P	£1.99
QQ03D	MC6845	£10.55■
WQ48C	MC6850P	£2.99
WQ49D	MC6852P	£2.95
WQ50E	MC6875L	£6.32
HQ61R	MEL 12	38p■
QH54J	MJE340	75p
WQ51F	MJE350	£1.15
*QH55K	MJE2955=TIP2955	99p
*QH56L	MJE3055=TIP3055	81p■
QH57M	MJ2501	£3.20
BL38R	MJ2955	£1.10
QH58N	MJ3001	£2.40
YY92A	MK50395	£10.50
YH67X	ML922	£5.25
YH68Y	ML928	£2.40
YH69A	ML929	£2.40
QH59P	MPF102	66p
QH60Q	MPSA14	34p
QH61R	MPSA65	45p
QH62S	MPS3638	16p
QH63T	MPS3638A	18p
BL23A	MS4A	£2.95
WQ53H	MVAM115	£2.10
WQ54J	NE531	£1.65
WQ55K	NE 544	£2.18
QH66W	NE 555	21p
QH67X	NE 556	62p
WQ56L	NE 565	£1.34
QH68Y	NE 566	£1.60■
QH69A	NE 567	£1.30■
*YY87U	NE571	£4.77
YY68Y	NE5534A	£2.45
YY67X	NE5539	£7.85
YG38R	NSM4000A	£7.99■
QH70M	OA47	12p
QH71N	OA90	9p
QH72P	OA91	8p
QH73Q	OA95	8p
QH74R	OA200	8p
QH75S	OA202	13p
QH77J	OC28	DIS
QH78K	OC35	£1.35
QH82D	OC45	47p
QH83E	OC70	38p
QH84F	OC71	31p
QH85G	OC72	42p
QH87U	OC81	42p
QH89W	OC83	45p
QH91Y	OC170	95p
QH92A	OC171	99p
QH93B	PN3643	30p
WQ57M	PW01	95p
WQ58N	PW06	99p
WQ59P	RO-3-2513	£8.95
QL00A	R2008B	£2.25
QL02C	SAM77	£1.20
QL05F	SC146D	£1.55
WQ60Q	SFF96364	£9.45
QL06G	SG1495D	£3.95
QL07H	SG3402	£3.78
WQ61R	SH120A	£6.65
YH66W	SL490	£3.35
QL08J	ST2	25p
QL09K	S005	47p
QL10L	S04	52p
WQ62S	TAA 550	35p
QL11M	TAG1/100	£1.45
QL12N	TAG1/600	£1.20
BL35Q	TBA 651	£2.25
QL13P	TBA810P	95p
WQ63T	TBA820M	70p
YY79L	TCA350Z	£3.95
WQ64U	TCA4500A	£3.35
*WH20W	TDA1022	£6.75
YY76H	TDA1024	£1.49
YY70M	TDA2005M	£8.25
WQ66W	TDA2006	£1.65
WQ67X	TDA2030	£1.95
*YY86T	TDA3410	£1.90
QL15R	TIP31A	39p
QL16S	TIP32A	39p
WQ71N	TIP33A	78p
WQ72P	TIP34A	99p
QL17T	TIP41A	49p
QL18U	TIP42A	45p
WQ73Q	TIP122	99p
WQ74R	TIP127	75p
QL19V	TIS43	55p
WQ75S	TL170C	55p
WQ76H	TL172C	76p
YY77J	TL430C	85p
YY78K	TL497A	£1.65
YY88V	TMS1121	£8.95
QL20W	uA709C	75p
BL22Y	uA723C TO99	85p
QL21X	uA723C 14-pin DIL	55p
QL22Y	uA741C 8-pin DIL	23p
QL23A	uA741C 14-pin DIL	78p
QL24B	uA747C	75p
QL25C	uA748C	52p
QL26D	uA78L05AWC	45p
WQ77J	uA78L12AWC	45p
QL27E	uA78L15AWC	45p
QL28F	uA78M05UC	79p
QL29G	uA78M12UC	79p
QL30H	uA78M15UC	79p
WQ78K	u78MGU1C	£1.25
QL31J	uA7805UC	78p
QL32K	uA7812UC	78p
QL33L	uA7815UC	78p
WQ79L	uA78GU1C	£1.25
QL34M	uA7805KC	£1.65
QL35Q	uA7815KC	£1.65
WQ80B	uA78H05KC	£5.55■
WQ81C	uA78H12KC	£6.49
WQ82D	uA78H15KC	DIS
WQ83E	uA78HGKC	£6.25
WQ84F	uA78P05SC	£8.25
WQ85G	uA79L05AWC	58p
WQ86T	uA79L12AWC	63p
WQ87U	uA79L15AWC	75p
WQ88V	uSA79M05UC	89p
WQ89W	uA79M12UC	89p
WQ90X	uA79M15UC	89p
WQ91Y	uA79MGU1C	£1.20
WQ92A	uA7905UC	£1.38
WQ93B	uA7912UC	95p
†QL36P	uA7915UC	84p■
WQ94C	uA79GU1C	£1.25
WQ95D	uA79HGKC	£8.59
QQ27E	VK10KM	83p■
QQ28F	VK1010	£1.35
QQ29G	VK1011	£1.35
WQ96E	VN46AF	£1.10■
WQ97F	VN66AF	£1.55
WQ98G	VN88AF	£1.37
QQ11M	VQ1000CJ	£4.30■
QL37S	W005	28p■
QL38R	W01	34p
QL39N	W02	38p
QL40T	W04	39p
QL41U	ZN414	£1.25
QL42V	ZS120	44p
QL43W	ZTX107	18p
QL44X	ZTX108	15p
QL45Y	ZTX109	19p
QL46A	ZTX300	16p
QL47B	ZTX301	20p
QL48C	ZTX302	22p■
QL50E	ZTX304	24p
QL54J	ZTX326	98p■
QL56L	ZTX330	26p
QL57M	ZTX331	28p
QL60Q	ZTX500	21p
QL62S	ZTX502	19p
QL64U	ZTX504	27p
QL66W	ZTX530	29p
QL67X	ZTX531	33p
QL68Y	ZTX541	31p
QL69A	ZTX542	33p
QL70M	Z5J	£2.84
QW00A	Z80-CPU	£7.95
QW01B	Z80-CTC	£4.50
QW03D	Z80-PIO	£4.25
QW04E	Z80-SIO	£19.00
QL71N	1N914	4p
QL72P	1N916	5p
QL73Q	1N4001	5p
QL74R	1N4002	4p■
QL75S	1N4003	6p
QL76H	1N4004	6p
QL77J	1N4005	6p
QL78K	1N4006	6p
QL79L	1N4007	7p
QL80B	1N4148	4p
QL81C	1N5400	15p
QL82D	1N5401	12p■
QL83E	1N5402	16p
QL84F	1N5404	19p
QL85G	1N5406	20p
QL86T	1N5407	21p
QL87U	1N5408	19p
QL88V	1S921	9p
QH46A	1458C	45p
QW05F	1702 1000ns	£4.10
QR00A	2N697	11p■
QR01B	2N706	26p
QR03D	2N708	35p
QR04E	2N1302	DIS
QR05F	2N1303	DIS
QR06G	2N1304	DIS
QR09K	2N1711	39p
QR10L	2N1893	32p
QR11M	2N2219	31p
QR12N	2N2369A	22p
QR13P	2N2484	28p
QR14Q	2N2646	55p
QR15R	2N2647	95p
QR16S	2N2904	31p
QR17T	2N2905	31p
QR18U	2N2906	26p
QR19V	2N2907	26p
QR20W	2N2926Or	12p
QR21X	2N2926Ye	12p
QR22Y	2N2926Gn	12p
QR23A	2N3053	34p
QR24B	2N3054	66p
BL45Y	2N3055	75p
QR25C	2N3525	£1.85
QR26D	2N3702	11p■
QR27E	2N3703	10p
QR28F	2N3704	10p
QR29G	2N3705	12p
QR30H	2N3706	14p
QR31J	2N3707	12p
QR32K	2N3708	11p
QR34M	2N3711	11p
QW07H	2N3772	£1.95
QR35Q	2N3773	£2.70■
QR36P	2N3819	32p
QR37S	2N3823	65p
QR38R	2N3866	£1.10■
QR39N	2N3903	17p
QR40T	2N3904	17p
QR41U	2N3905	15p
QR42V	2N3906	14p
QR43W	2N4058	12p
QR44X	2N4060	12p
QR45Y	2N4061	17p■
QR46A	2N4062	12p
QR47B	2N4871	69p
QR49D	2N5458	62p
QR50E	2N5459	29p
QR51F	2N6073	£1.20
QW08J	2N6609	£3.55■
QQ30H	2SA872	39p
QQ31J	2SB716	30p
QQ32K	2SC1307	£2.18
QQ33L	2SD756	30p
QQ34M	2SJ48	£2.50
QQ35Q	2SJ49	£2.90
QW09K	2SJ50	£4.54
QQ36P	2SK133	£2.50
QQ37S	2SK134	£2.90
QW10L	2SK135	£4.30
QW11M	2102 450ns	£1.95■
QW12N	2114 450ns	£1.30
QW13P	2708 450ns	£4.40
QQ07H	2716 450ns	£3.23
QQ08J	2732 450ns	£5.19■
QQ09K	2764 450ns	NYA
QR52G	3N140	£1.12
QR53H	3N141	DIS
QH51F	3403	88p
QX00A	4000BE	24p
QX01B	4001BE	17p
QL03D	4001UBE	17p
QX02C	4002BE	16p
QX03D	4006BE	68p
QX04E	4007UBE	18p
QW14Q	4008BE	62p
QX05F	4011BE	16p
QL04E	4011UBE	24p
QX06G	4012BE	18p
QX07H	4013BE	35p
QW15R	4014BE	89p
QW16S	4015BE	66p
QX08J	4016BE	32p
QX09K	4017BE	48p
QX10L	4018BE	68p
QW17T	4019BE	42p
QX11M	4020BE	61p
QW18U	4021BE	49p
QW19V	4022BE	66p
QX12N	4023BE	23p
QX13P	4024BE	45p
QX14Q	4025BE	22p
QX15R	4026BE	£1.20
QX16S	4027BE	38p
QX17T	4028BE	58p
QW20W	4029BE	77p
QW21X	4031BE	£1.70
QW22Y	4032BE	75p
QW23A	4033BE	95p
QW24B	4034BE	£1.95
QW25C	4035BE	60p
QW26D	4038BE	85p
QW27E	4040BE	59p
QW28F	4041UBE	83p
QX19V	4042BE	60p
QW29G	4043BE	70p
QW30H	4044BE	65p
QW31J	4045BE	£1.40
QW32K	4046BE	75p
QX20W	4047BE	75p
QW33L	4048BE	60p
QX21X	4049UBE	30p
QX22Y	4050BE	30p
QW34M	4051BE	78p
QW35Q	4052BE	78p
QW36P	4053BE	78p
QW37S	4054BE	95p
QW38R	4055BE	85p
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QW39N	4056BE	£1.12
QW40T	4060BE	£1.20
QW41U	4063BE	£1.12
QX23A	4066BE	36p
QW42V	4067BE	£3.69
QX24B	4068BE	23p
QX25C	4069UBE	20p
QX26D	4070BE	26p
QW43W	4071BE	21p
QX27E	4072BE	21p
QW44X	4073BE	21p
QW45Y	4075BE	20p■
QW46A	4076BE	60p
QW47B	4077BE	26p
QX28F	4078BE	26p
QW48C	4081BE	24p
QW49D	4082BE	21p
QW50E	4085BE	65p
QW51F	4086BE	65p
QW52G	4089BE	£1.40
QW53H	4093BE	43p
QW54J	4094BE	£1.20
QW55K	4095BE	75p
QW56L	4097BE	£3.20
QX29G	4098BE	85p
QW57M	4099BE	95p
QW58N	40100BE	£1.49
QW59P	40101BE	90p
QW60Q	40102BE	£1.50
QW61R	40103BE	85p
QW62S	40104BE	85p
QW63T	40105BE	85p
QW64U	40106BE	75p
QW65V	40107BE	60p
QW66W	40108BE	£4.30
QW67X	40109BE	95p
QW68Y	40110BE	£1.10
QW69A	40160BE	£1.25
QW70M	40161BE	£1.20
QW71N	40162BE	85p
QW72P	40163BE	£1.60
QW73Q	40174BE	85p
QQ38R	40175BE	95p
QW74R	40181BE	£1.99
QW75S	40182BE	85p
QW76H	40192BE	£1.25
QW77J	40193BE	80p
QW78K	40194BE	85p
QW79L	40257BE	£1.10
QX34M	40673	£1.75
QW93B	4116 250ns	£1.30
QQ05F	4118 250ns	£4.45
QQ06G	4164 250ns	£6.25■
XX01B	4136	75p
QW80B	4151	89p
XX02C	4195	£1.45
QQ39N	4412VP	£8.00
QX30H	4416BE	£1.92
QQ40T	4459BE	£8.00
QW81C	4502BE	£1.19
QQ41U	4503BE	95p
QW82D	4508BE	£2.10
QW83E	4510BE	68p
QX31J	4511BE	68p
QW84F	4512BE	£1.49
QW85G	4514BE	£1.55
QW86T	4515BE	£1.55
QW87U	4516BE	60p
QX32K	4518BE	63p
QX33L	4520BE	78p
QQ42V	4521BE	£2.00
QQ43W	4522BE	88p■
QQ44X	4526BE	95p
QW88V	4527BE	£1.15
QX29G	4528BE see 4098BE	
QQ45Y	4529BE	£1.42
QQ46A	4530BE	97p
QW89W	4532BE	£1.10
QQ47B	4541BE	£1.40
QQ48C	4551BE	£1.59
QW90X	4555BE	50p
QW91Y	4556BE	58p
QQ49D	4568BE	£3.15
QQ50E	4583BE	£1.79
QQ51F	45100BE	£2.90
QX35Q	5W Zener 5V6	£1.27
QX36P	5W Zener 8V2	£1.27
YH31J	5101-L1	£3.48
QQ04E	6402	£5.80
QQ02C	6502	£5.48
QX37S	7400	17p■
YF00A	74LS00	17p■
QX38R	7401	17p■
YF01B	74LS01	17p■
QX39N	7402	17p■
YF02C	74LS02	17p■
QX74R	7403	20p■
YF03D	74LS03	17p■
QX40T	7404	21p
YF04E	74LS04	20p■
QX41U	7405	21p■
YF05F	74LS05	20p■
QX75S	7406	29p
QX76H	7407	29p
QX42V	7408	21p■
YF06G	74LS08	22p
QX77J	7409	22p■
YF07H	74LS09	20p■
QX43W	7410	17p■
YF08J	74LS10	17p■
QX44X	7411	24p
YF09K	74LS11	20p■
YF10L	74LS12	17p■
QX45Y	7413	28p■
YF11M	74LS13	31p■
QX46A	7414	42p■
YF12N	74LS14	44p
YF13P	74LS15	17p■
QX78K	7416	31p
QX79L	7417	30p
QX47B	7420	23p■
YF14Q	74LS20	17p■
QX48C	7421	40p■
YF15R	74LS21	20p■
YF16S	74LS22	17p■
QX80B	7425	28p

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QX81C	7426	22p
YF17T	74LS26	22p■
QX49D	7427	29p
YF18U	74LS27	29p
YF19V	74LS28	44p
QX50E	7430	17p■
YF20W	74LS30	17p■
QX51F	7432	36p
YF21X	74LS32	21p■
YF22Y	74LS33	40p
YF23A	74LS37	21p■
QX82D	7438	26p
YF24B	74LS38	22p■
QX53H	7440	24p
YF25C	74LS40	40p■
QX54J	7442	48p■
YF26D	74LS42	36p
QX55K	7447A	55p■
QQ52G	74LS47	65p■
QQ53H	74LS48	68p■
QX83E	7451	22p■
YF27E	74LS51	17p■
QX84F	7454	22p■
YF28F	74LS54	30p■
YF29G	74LS55	40p
QX56L	7470	36p
QX57M	7472	35p■
QX58N	7473	32p
YF30H	74LS73	28p■
QX59P	7474	32p
YY83E	74ALS74	£3.35
YF31J	74LS74	26p■
QX60Q	7475	45p■
YF32K	74LS75	31p■
QX61R	7476	32p
YF33L	74LS76	28p■
YF34M	74LS78	68p
QX62S	7481	£1.75
QX85G	7483	50p■
QX63T	7485	77p
YF35Q	74LS85	70p■
QX64U	7486	28p■
YF36P	74LS86	36p
QX65V	7489	£3.10
QX66W	7490	32p■
YF38R	74LS90	36p■
QX86T	7491	£1.20
QX67X	7492	32p■
YF39N	74LS92	36p■
QX68Y	7493	35p■
YF40T	74LS93	36p■
QX69A	7494	39p
QX70M	7495	48p■
YF41U	74LS95	£1.20
QX87U	7496	50p■
YF42V	74LS96	£1.69
QX71N	74107	26p
YF43W	74LS107	41p
QX88V	74109	53p■
YF44X	74LS109	34p■
YF45Y	74LS112	34p■
YF46A	74LS113	40p
YF47B	74LS114	39p■
QX72P	74118	£2.30
QX73Q	74121	33p■
WH00A	74122	48p■
QQ54J	74LS122	62p■
WH01B	74123	42p
YF48C	74LS123	62p■
WH02C	74LS124	£2.15
YF49D	74LS125	33p■
YF50E	74LS126	33p■
WH03D	74132	55p■
YF51F	74LS132	45p■
YF52G	74LS136	32p■
QQ55K	74LS137	£2.20
YF53H	74LS138	38p■
YF54J	74LS139	44p■
WH05E	74141	78p
WH06G	74145	67p
YF55K	74LS145	£1.65
QX89W	74150	80p
WH07H	74151	65p
YF56L	74LS151	43p■
YF57M	74LS153	49p■
WH08J	74154	78p■
YF58N	74LS154	98p
YF59P	74LS155	37p■
YF60Q	74LS156	57p
YF61R	74LS157	35p■
YF62S	74LS158	46p■
WH09K	74160	67p■
YF63T	74LS160	49p■
YF64U	74LS161	49p■
YF65V	74LS162	53p■
YF66W	74LS163	49p■
WH10L	74164	66p■
YF67X	74LS164	55p■
YF68Y	74LS165	£1.40
YF69A	74LS166	£1.95
YF70M	74LS168	£1.20
YF71N	74LS169	99p
YF72P	74LS170	£2.99
YF73Q	74LS173	65p
WH11M	74174	81p■
YF74R	74LS174	62p
YF75S	74LS175	58p
YF76H	74LS181	£2.95
YF77J	74LS189	£4.95
YF78K	74LS190	58p■
YF79L	74LS191	68p■
WH12N	74192	70p■
YF80B	74LS192	62p■
QX90X	74193	66p■
YF81C	74LS193	65p■
WH13P	74194	55p■
YF82D	74LS194	85p
YF83E	74LS195	45p■
WH14Q	74196	65p■
YF84F	74LS196	61p■
YF85G	74LS197	88p■
YF86T	74LS221	63p
YF87U	74LS240	99p
YF88V	74LS241	99p
YF89W	74LS242	99p■
YF90X	74LS243	89p■
QQ56L	74LS244	87p■
YF91Y	74LS245	£1.95
YF92A	74LS251	53p■
YF93B	74LS253	53p■
YF94C	74LS256	£1.36
YF95D	74LS257	52p■
YF96E	74LS258	55p
YF97F	74LS259	£1.40■
YF98G	74LS261	£2.25
YF99H	74LS266	32p
YH00A	74LS273	£1.50
YH01B	74LS279	44p
YH02C	74LS283	69p
YH03D	74LS290	£1.30

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YH04E	74LS293	96p
YH05F	74LS295	£2.35
YH06G	74LS298	£1.75
YH07H	74LS299	£4.25
YH08J	74LS323	£6.75
YH09K	74LS363	£3.25
YH10L	74LS364	NYA
YH11M	74LS365	39p
YH12N	74LS366	62p■
YH13P	74LS367	62p■
YH14Q	74LS368	43p
YH15R	74LS373	£1.15
YH16S	74LS374	£1.30
YH17T	74LS375	£1.30
YH18U	74LS377	£2.90
YH19V	74LS378	£1.40
YH20W	74LS379	£2.40
YH21X	74LS390	£1.45
YH22Y	74LS393	£1.40
YH23A	74LS395	£1.35
YH24B	74LS398	£1.99
YH25C	74LS399	£2.50
QQ57M	74LS442	£3.50
QQ58N	74LS443	£6.85
YH26D	74LS490	£2.40
YH27E	74LS568	NYA
YH28F	74LS569	NYA
QQ59P	74LS600	NYA
QQ60Q	74LS606	£23.60
QQ61R	74LS608	NYA
QQ62S	74LS610	NYA
YH29G	74LS670	£1.46
QQ63T	74LS684	£4.75
YH30H	74C917	£8.85
YH32K	76477	£3.45
YH33L	76489	£4.75
YH34M	8T28	£3.30
YH35Q	8T95	£2.55
YH36P	8T97=74LS367	63p
YH37S	8T98	£2.35
YH38R	8038 CCPD	£4.69
YH39N	8069 DCQ	£2.35
YH40T	8080A	£4.95
YH41U	8085A	£5.99
YH43W	8211 CPA	£3.25
YH44X	8212	£1.95
YH45Y	8216	£1.95
YH46A	8224	£2.68
YH47B	8228	£4.45
YH48C	8250	£9.95
YH49D	8251	£4.60
YH50E	8255A	£4.40
YH51F	8279	£9.95
YH52G	82S126M1	£3.49

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1981 Catalogue Page No.		VAT inclusive PRICE
QH36P	LM301A	27p
QH37S	LM308	95p

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ54J	NE531	£1.65
YY68Y	NE5534A	£2.45
QL20W	uA709C	75p
QL22Y	uA741C 8-pin DIL	23p
QL23A	uA741C 14-pin DIL	78p
QL24B	uA747C	75p
QL25C	uA748C	52p
QH46A	1458C	45p
QH51F	3403	88p
XX01B	4136	75p
QH28F	CA3130T	£1.10■
QH29G	CA3140T	99p
WQ21X	CA3240E	£1.38

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1981 Catalogue Page No.		VAT inclusive PRICE
QH35Q	LH0042C	£4.30■
WQ30H	LF351	56p
WQ31J	LF353	99p
WQ29G	LF347	£2.55
YY69A	LF13741	55p
YH58N	CA3080E	87p■
YH64U	LM13600N	£1.39
QH48C	MC3302P	80p

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1981 Catalogue Page No.		VAT inclusive PRICE
QH50E	MC3360P	DIS
WQ63T	TBA820M	70p
QH38R	LM377	£1.77

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ36P	LM389	£1.49
QH39N	LM379S	£5.29
QH40T	LM380	75p

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1981 Catalogue Page No.		VAT inclusive PRICE
*WQ33L	LM383	£1.61
BY73Q	8W Amp PCB	62p
LW36P	8W Amp Kit	£4.45
WQ34M	LM384	£1.44
QL13P	TBA810P	95p
BR02C	5W Amp PCB	£1.45
YY70M	TDA2005M	£8.25

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ67X	TDA2030	£1.95
YQ43W	15W Amp Kit	£6.45
YQ35Q	15W Amp PCB	£1.25
YQ36P	15W Amp Bracket	65p
YQ38R	30/2 PSU PCB	£1.40
YQ37S	15W Amp Module	£6.49

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ66W	TDA2006	£1.65
QH44X	MC1303	DIS
QH41U	LM381	£1.57■
BR04E	LM381 PCB	£2.15

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1981 Catalogue Page No.		VAT inclusive PRICE
YY84F	LM382	£1.31■
*YY87U	NE571	£4.77
*YY86T	TDA3410	£1.90
WQ35Q	LM387	£1.25

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1981 Catalogue Page No.		VAT inclusive PRICE
QH49D	MC3340P	£1.35
YY85G	LM1818	£1.95
QB21X	AY-1-0212	£8.20
YY81C	M083	£4.75
WH22Y	M087	£4.95

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1981 Catalogue Page No.		VAT inclusive PRICE
HQ51F	AY-1-5050	£1.99
HQ53H	Piano IC Kit	£38.44
HQ52G	AY-1-1320	£4.99
HQ71N	M251	£12.20
†QH64U	M252	£8.95
WH21X	M254	£7.49
YY90X	M108	£18.25

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1981 Catalogue Page No.		VAT inclusive PRICE
YY91Y	M147	£6.51
YY89W	AY-3-1350	£5.95■
*WH20W	TDA1022	£6.75
YH33L	76489	£4.75

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1981 Catalogue Page No.		VAT inclusive PRICE
YY79L	TCA350Z	£3.95
YH32K	76477	£3.45
YQ42V	Sound Effects PCB	£1.10

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ61R	SH120A	£6.65
QH27E	CA3089E	£2.70
WQ20W	CA3189E	£1.95

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ37S	LM1820	£1.80
BL35Q	TBA 651	£2.25
WQ64U	TCA4500A	£3.35
QH45Y	MC1310P	£2.30
BR03D	Decoder PCB	£1.72

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ17T	AY-3-8115	DIS
QL41U	ZN414	£1.25

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1981 Catalogue Page No.		VAT inclusive PRICE
QH47B	MC1496	89p
QL06G	SG1495D	£3.95
QL07H	SG3402	£3.78
QH26D	CA3046	72p■

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1981 Catalogue Page No.		VAT inclusive PRICE
YH66W	SL490	£3.35
YH67X	ML922	£5.25

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1981 Catalogue Page No.		VAT inclusive PRICE
YH68Y	ML928	£2.40
YH69A	ML929	£2.40
YY71N	LM1871	£5.60
YQ69A	LM1871 Xmitter PCB	98p

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1981 Catalogue Page No.		VAT inclusive PRICE
YY72P	LM1872	£5.90
YQ70M	LM1872 Receiver PCB	95p
WQ55K	NE 544	£2.18
YQ71N	Servo Driver PCB	85p
WQ76H	TL172C	76p

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ75S	TL170C	55p
YG37S	CL8960	£29.95
YY99H	LM1830	£2.65
YY73Q	LM335Z	£1.23
*WQ40T	LM3911	£1.31

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1981 Catalogue Page No.		VAT inclusive PRICE
YY98G	AY-3-1270	£8.30
WQ41U	LM3914	£2.41
YY96E	LM3915	£2.93
YY97F	LM3916	£3.46
YQ66W	LM3914 PCB	85p

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1981 Catalogue Page No.		VAT inclusive PRICE
YH30H	74C917	£8.85
YY82D	DF412	£6.45
QB24B	AY-5-1224	DIS
BB53H	4-Dig Clock PCB 'A'	£1.10

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1981 Catalogue Page No.		VAT inclusive PRICE
FY90X	Crystal 6.5536MHz	£2.98
YY93B	ICM7045IPI	£14.20■
QB25C	AY-5-1230	£5.27

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1981 Catalogue Page No.		VAT inclusive PRICE
YY88V	TMS1121	£8.95
YY92A	MK50395	£10.50
QB26D	AY-5-4007D	£6.90

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1981 Catalogue Page No.		VAT inclusive PRICE
YY94C	ICM7216DIPI	£17.45
YY95D	ICM7226BIPI	£21.90
YH63T	ICM 7555	£1.25

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1981 Catalogue Page No.		VAT inclusive PRICE
QH66W	NE 555	21p
QH67X	NE 556	62p
QH68Y	NE 566	£1.60■
WQ56L	NE 565	£1.34

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1981 Catalogue Page No.		VAT inclusive PRICE
QH69A	NE 567	£1.30■
WQ39N	LM3909	87p■
YY76H	TDA1024	£1.49
YH43W	8211 CPA	£3.25
WQ32K	LM334	£1.10
YH39N	8069 DCQ	£2.35
WQ62S	TAA 550	35p

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1981 Catalogue Page No.		VAT inclusive PRICE
YY78K	TL497A	£1.65
YY77J	TL430C	85p
YY75S	ICL7660CPA	£3.24
XX02C	4195	£1.45
XX04E	15V Supply PCB	75p
BL22Y	uA723C TO99	85p
QL21X	uA723C 14-pin DIL	55p

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1981 Catalogue Page No.		VAT inclusive PRICE
YQ39N	0.1A Reg PSU PCB	£1.05
YQ40T	0.5/1A Reg V PS PCB	85p
YQ41U	0.5/1A Reg -V PS PCB	85p
YQ54J	0.5/1A Vareg Pos PCB	85p
YQ55K	0.5/1A Vareg Neg PCB	85p
*YY74R	L200	£2.69

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1981 Catalogue Page No.		VAT inclusive PRICE
QQ02C	6502	£5.48
WQ43W	MC6800P	£5.10
WQ44X	MC6802P	£5.99
WQ46A	MC6821P	£1.99
WQ48C	MC6850P	£2.99
WQ49D	MC6852P	£2.95
WQ50E	MC6875L	£6.32
QW00A	Z80-CPU	£7.95
QW03D	Z80-PIO	£4.25
QW04E	Z80-SIO	£19.00
QW01B	Z80-CTC	£4.50

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1981 Catalogue Page No.		VAT inclusive PRICE
YH40T	8080A	£4.95
YH41U	8085A	£5.99
YH46A	8224	£2.68
YH47B	8228	£4.45
YH50E	8255A	£4.40
YH49D	8251	£4.60
YH48C	8250	£9.95
YH51F	8279	£9.95
YH44X	8212	£1.95
YH45Y	8215	£1.95
YH34M	8T28	£3.30
YH35Q	8T95	£2.55
YH36P	8T97=74LS367	63p
YH37S	8T98	£2.35
WQ19V	AY-5-2376	£9.95

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ18U	AY-5-1013A	£5.98
QQ04E	6402	£5.80
WQ60Q	SFF96364	£9.45
QQ03D	MC6845	£10.55■
YH31J	5101-L1	£3.48
QW11M	2102 450ns	£1.95■
WQ45Y	MC6810AP 450ns	£1.98
QW12N	2114 450ns	£1.30
QQ05F	4118 250ns	£4.45
WQ42V	MCM4027 250ns	£1.88

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1981 Catalogue Page No.		VAT inclusive PRICE
QW93B	4116 250ns	£1.30
QQ06G	4164 250ns	£6.25■
QW05F	1702 1000ns	£4.10
QW13P	2708 450ns	£4.40
QQ07H	2716 450ns	£3.23

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1981 Catalogue Page No.		VAT inclusive PRICE
QQ08J	2732 450ns	£5.19■
QQ09K	2764 450ns	NYA
XY84F	Softy 2 System	£169.00
XY85G	Softy PSU	DIS
XY83E	EPROM Eraser	£42.95

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1981 Catalogue Page No.		VAT inclusive PRICE
WQ26D	ER1400	£9.99
WQ27E	ER3401	DIS
YH52G	82S126M1	£3.49
WQ59P	RO-3-2513	£8.95
YH38R	8038 CCPD	£4.69

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1981 Catalogue Page No.		VAT inclusive PRICE
YQ65V	8038 PCB	85p
QW80B	4151	89p
QQ01B	DAC0801LCN	£2.45
QQ00A	ADC0804LCN	£4.45
YH59P	ICL7109	£16.55
WQ38R	LM2917	£2.29

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1981 Catalogue Page No.		VAT inclusive PRICE
YQ67X	LM2917 PCB	85p
QW94C	7106	£8.95
QW95D	7107	£8.45
BY76H	7106/7 PCB	£1.45
WR29G	Transkt 3-Lead TO18	16p
WR30H	Transkt 4-Lead TO18	31p
WR31J	Transkt 3-Lead TO5	19p
WR32K	IC Skt 8-Lead	55p
WR33L	IC Skt 10-Lead	67p

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1981 Catalogue Page No.		VAT inclusive PRICE
WR24B	Kit TO3	8p
WR25C	Kit TO66	9p
WR27E	Kit SO55	9p
WR26D	Kit TO126	5p
WR23A	Kit (P) Plas	6p
BL17T	DIL Socket 8-pin	9p
BL18U	DIL Socket 14-Pin	11p
BL19V	DIL Socket 16-pin	12p
HQ76H	DIL Socket 18-pin	16p
HQ77J	DIL Socket 20-pin	17p
HQ78K	DIL Socket 22-pin	20p
BL20W	DIL Socket 24-pin	19p
BL21X	DIL Socket 28-pin	24p
HQ38R	DIL Socket 40-pin	31p
YX50E	ZIF Socket 24-Way	£3.40
XX14Q	Soldercons	90p
YG27E	Header 14-pin	54p
YG28F	Header 16-pin	63p
YG29G	Header 24-pin	£1.10
FR25C	Insertion Tool	80p

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1981 Catalogue Page No.		VAT inclusive PRICE
FL56L	Transistor Cover	10p
HQ79L	Heatsink 92F	14p
HQ80B	Heatsink 18F	19p
FL78K	Heatsink Clip-On	16p
WR34M	TO5 Chassis Heatsink	89p
FL59P	Vaned Heatsink TO3	46p
FL58N	Vaned Htsnk Plas Pwr	34p
FL57M	Vaned Heatsink IC	72p
HQ70M	Heatsink 2E	£2.55
FL41U	Heatsink 4Y	£1.70
HQ69A	50W Hi-Fi Heatsink	£1.95

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1981 Catalogue Page No.		VAT inclusive PRICE
HQ81C	8W Hi-Fi Heatsink	£1.17
FL42V	Flat Heatsink	£3.25
FL54J	Heatsink 10DN	£2.15
FL55K	Heatsink 10DNDR	£2.60
FL77J	Heatsink 6W-1	£5.50
YB26D	Heatsink 60DN	£13.95
FL79L	Thermpath	£3.60
*HQ00A	Small Thermpath	99p
WY08J	Standard Fan	£19.90

SPEAKERS

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1981 Catalogue Page No.		VAT inclusive PRICE
HY12N	Ultrasonic Transducr	£6.20
FL39N	Buzzer 6V	88p
FL40T	Buzzer 12V	88p
FL38R	AC Bell	£1.90
FL37S	Bell Xformer	£4.95
FQ08J	Bell Push	£1.10
FQ09K	Nameplate Bell Push	56p
YB25C	Baby Siren	£9.25
LH96E	Plastic Siren	£5.50
LH97F	Star War Siren	£5.95

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1981 Catalogue Page No.		VAT inclusive PRICE
LH98G	Hawaii Five-O Siren	£24.95
XQ71N	Re-entrant Horn Sndr	£26.50
XQ72P	Megaphone	£49.95
XY76H	Pistol Grip Megphone	£49.95
XQ73Q	Car PA 8W	£8.25
XQ74R	Car PA 15W	£12.95

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1981 Catalogue Page No.		VAT inclusive PRICE
YW52G	2in Piezo Tweeter	£2.49
WF54J	Direct Rad Piezo	£3.95■
WF09K	Piezo Horn Flush	£5.25
WF55K	Piezo Horn Recessed	£5.25
WF56L	Wide Angle Piezo	£7.90
LB23A	Mag Earpiece 2.5mm	25p
LB24B	Mag Earpiece 3.5mm	25p
LB25C	Crystal Earpiece	55p
YW57M	Stethoscope	75p
WB04E	L/S Lo-Z 388	85p
WB05F	L/S Lo-Z 458	89p
WB08J	L/S Lo-Z 508	89p
WB09K	L/S Lo-Z 568	89p
WB13P	L/S Lo-Z 658	89p
WF57M	Hi-Z L/S 64R	99p
YW53H	L/S Lo-Z 768	99p
WF58N	3 inch Tweeter	£1.45

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1981 Catalogue Page No.		VAT inclusive PRICE
YW54J	15W Cone Tweeter	£2.85
WF24B	Multi-Cell Tweeter	£5.95
WF33L	Free Stand Tweeter	£5.95
WF43W	Dome Tweeter	£5.45
WF44X	Rectangular Tweeter	£5.45
*WF02C	Crossover 2-Way	£4.20
WF03D	Crossover 3-Way	£5.20

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1981 Catalogue Page No.		VAT inclusive PRICE
WF45Y	Escutcheon Crssvr	£4.99
WF46A	Controlled Crossover	£10.69
WF47B	Low-Cost 4in Spkr	£1.98
WB27E	Rd Spkr CM420	£2.56
YW55K	Plastic Car Grille	90p
YW56L	Metal Car Grille	DIS
WF48C	Hvy Duty Car Spkr	£6.45
WF50E	Elliptcal Spkr CM641	£3.35
WF18U	Elliptcal Spkr CM742	£4.45
WF23A	Elliptcal Spkr CM852	£5.20
WY13P	Elliptcal Spkr LT853	£6.45

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1981 Catalogue Page No.		VAT inclusive PRICE
WF00A	Rd Speaker LT530	£6.95
WF52G	Rd Speaker LT610	£5.75
WF08J	Rd Speaker CM820	£5.95
WF11M	Rd Speaker LT830	£7.30
WF12N	Rd Speaker LT840	£11.45
WF53H	20W Squawker	£3.25
WY15R	40W Squawker	£5.25
XQ77J	Fane 50 4R	£19.95
XB26D	Fane 50 8R	£21.45
XQ78K	Disco 80 4R	£29.45
XB27E	Disco 80 8R	£29.45
XQ79L	Forte 1250TC 8R	£21.75
XQ80B	Forte 1250TC 16R	£21.75
XQ81C	Forte C1285TC 8R	£28.45
XQ82D	Forte C1285TC 16R	£28.45

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1981 Catalogue Page No.		VAT inclusive PRICE
XQ83E	C15 Bass 8R	£57.80
XQ84F	C15 Bass 16R	£57.80
XB28F	Power L/S Cabinet	£49.00■
XQ05F	15 inch Power Cab	DIS
AF33L	Mini Speaker System	£45.50
AF34M	5W Spkr in Cab	£9.95
AF35Q	15W Spkr Pair	£33.50

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1981 Catalogue Page No.		VAT inclusive PRICE
AF31J	20W Spkr Pair	£63.00
AF32K	PA Spkr in Cab	£21.99
XY79L	Ceiling Speaker	£11.75
YL15R	Bracket Minor 5	£6.50
YL16S	Bracket Bek 100	£13.90
WY14Q	Spkr Selector	DIS

SWITCHES

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1981 Catalogue Page No.		VAT inclusive PRICE
FH97F	SPST Ultra Min Tggle	66p
FH98G	SPDT Ultra Min Tggle	69p
FH99H	DPDT Ultra Min Tggle	75p■
FH00A	Sub-Min Toggle A	70p
FF70M	Sub-Min Toggle J	80p
FH01B	Sub-Min Toggle B	89p
FH02C	Sub-Min Toggle C	89p
FH03D	Sub-Min Toggle D	£1.06
FH04E	Sub-Min Toggle E	99p
FF71N	Sub-Min Toggle K	£2.35
FH05F	Sub-Min Toggle F	£1.29
FH06G	Sub-Min Toggle G	£1.10
FH07H	Sub-Min Toggle H	£1.25
FF72P	Sub-Min Toggle L	£2.15
FH08J	4-Pole SM Toggle	£2.35
FH39N	Toggle Sw	60p
YL01B	Toggle Switch Cover	47p
FH10L	Std Toggle SPST	50p
FH11M	Std Toggle SPDT	57p
FH12N	Std Toggle DPDT	77p
FH16S	H/D Toggle Type 1	DIS
FH17T	H/D Toggle Type 4	£4.25
FH18U	H/D Toggle Type 7	£1.95
FH19V	H/D Toggle Type 8	£4.40
FH20W	H/D Toggle Type 9	£4.30

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FH13P	Duck Bill Toggle	55p
FH14Q	Long Arm Tgl Locking	90p
FH15R	Long Arm Tgl Flasher	99p
[illegible]	Chrome Bar Toggle	85p
YX64U	Min Rocker SPST	69p
YX65V	Min Rocker DPDT	£1.15
FH21X	Hekla Switch Black	DIS
FH22Y	Hekla Switch Blue	DIS
FH23A	Hekla Switch Green	DIS
FH24B	Hekla Switch Luminous	DIS
FH25C	Hekla Switch Red	DIS
FH26D	Hekla Switch White	DIS
FH27E	Hekla Switch Yellow	DIS
FH30H	SPST Rocker	39p
FH31J	SPDT Rocker	49p
YR68Y	Rocker Neon	63p
YR69A	Rocker Sw DP	69p
FH34M	DPDT Rocker	98p
•YR70M	Dual Rocker Neon	£1.10
XX26D	DIL Switch SPST Dual	£1.20
XX27E	DIL Switch SPST Octl	£1.50
XX28F	DIL Switch SPDT Sgl	95p
XX29G	DIL Switch SPDT Quad	£3.95

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FF73Q	Rotary SW12B	70p
FF74R	Rotary SW6B	70p
FF75S	Rotary SW4B	70p
FF76H	Rotary SW3B	70p
FH42V	Rotary SW12	70p
FH43W	Rotary SW6	70p
FH44X	Rotary SW4	70p
FH45Y	Rotary SW3	70p
FF83E	Thumbwheel Decimal	£4.95
FF84F	Thumbwheel BCD	£4.55
FF86T	Thumbwheel Mtg Kit	£1.35
YR77J	Push Wheel BCD	£5.45
YR78K	Push Wheel Spacer	48p
YR79L	Push Whl End Cheeks	99p
FH40T	Key Switch	£3.60
FH57M	Rotary Mains	75p
FH95D	Roller Microswitch	£1.15

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FH46A	Maka Shaft	£1.10
FH47B	Maka Wafer 1p 12w	£1.06
FH48C	Maka Wafer 2p 6w	£1.06
FF81C	Maka Wafer 2p 9w	£1.25
FH50E	Maka Wafer 4p 3w	£1.10
FH51F	Maka Wafer 6p 2w	£1.17
FH52G	Maka Wafer 1p 12w MB	75p
FH53H	Maka Wafer 2p 6w MB	£1.05
FF82D	Maka Wafer 2p 9w MB	29p
FH54J	Maka Mains	63p
FH55K	Maka Screen	5p
FF87U	Click Switch	30p
FF88V	Click Cap Black	18p
FF89W	Click Cap Blue	18p
FF90X	Click Cap Green	18p
FF91Y	Click Cap Grey	18p
FF92A	Click Cap Ivory	18p
FF93B	Click Cap Red	18p
FF94C	Click Cap White	18p
FF95D	Click Cap Yellow	18p
FF61R	Keyboard Switch	23p
FF62S	Keytop 1 Position	18p
FF63T	Keytop 2 Position	29p■
FF64U	Keytop 3 Position	56p
FF65V	ASCII Transparency	£1.35
YR71N	Switch Contact Sheet	£1.49

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FF77J	SP Slide	12p
FH35Q	Sub-Min Slide	15p
FF79L	Long Chrome Slide	22p
FH36P	Std Slide Switch	15p
FH38R	4-Pole Slide	69p
YR67X	HQ Push Switch	39p
FH59P	Push Switch	17p
FH60Q	Break Push	23p
FH91Y	Motor Start Press	43p
FF96E	Square Push Black	77p
FF97F	Square Push Green	77p
FF98G	Square Push Red	77p
FF99H	Square Push Yellow	77p
YW41U	Square Psh Lck Black	75p
YW42V	Square Psh Lck Green	DIS
YW43W	Square Psh Lck Red	75p
YW44X	Square Psh Lck Yllow	75p
FH41U	Pushlock SPCO	£1.20
FH66W	Pushlock DPCO	£1.45
FH94C	Pressil Switch	28p

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FH92A	Press Toe Sw Type 1	£1.20
FH93B	Press Toe Sw Type 2	£1.95
•LB64U	Foot Switch 2.5mm Jk	£4.25
FH37S	Mains Push	£1.10
LB91Y	Flasher Unit 2 Way	£5.75
LQ00A	Beginners Morse Key	£1.90
LQ01B	Professl Morse Key	£5.40
HY00A	Touch Pads Rect	22p
HY01B	Touch Pads Tri	27p
YR88V	Solenoid 12V	£4.75
YR89W	Solenoid 240V AC	£4.85

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FH67X	Latchswitch 2 pole	46p
FH68Y	Latchswitch 4-pole	59p
FH69A	Latchswitch 6-pole	99p
FH70M	Latchswitch 8-pole	£1.45
FH71N	Latchswitch 10-pole	£1.25
BW11M	Latchsoft 2-pole	60p
BW12N	Latchsoft 4-pole	£1.20
FH72P	Latchdummy	32p
FH74R	Mains Latchswitch	£1.59
FH75S	Latchbracket Single	13p
FH76H	Latchbracket 2-way	38p
FH78K	Latchbracket 4-way	45p
FH80B	Latchbracket 6-way	55p
FH82D	Latchbracket 8-way	59p
FH84F	Latchbracket 10-way	69p

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FL31J	Rd Latchbutton Black	14p
FL32K	Rd Latchbutton Green	14p
FL33L	Rd Latchbutton Grey	14p
FL34M	Rd Latchbutton Red	14p
FL35Q	Rd Latchbutton White	14p
FL36P	Rd Latchbutton Chrm	22p
BW13P	Sm Latchbutton Black	11p
BW14Q	Sm Latchbutton Chrm	33p
FH61R	Rct Latchbutton Blk	14p
FH62S	Rct Latchbutton Grey	14p

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FH63T	Rct Latchbutton Red	14p
FH64U	Rct Latchbutton White	14p
FH87U	Magiclight Button Bl	23p
FH88V	Magiclight Buttn Grn	DIS
FH89W	Magiclight Button Or	42p
FH90X	Magiclight Button Yl	49p
BW15R	Latchbush Blue	39p
BW16S	Latchbush Green	45p
BW17T	Latchbush Orange	45p
BW18U	Latchbush Yellow	39p

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YX94C	Ultra Min Relay SPDT	96p
YX95D	Ultra Min Relay DPDT	£1.49
YX96E	3A Min Relay	98p
YX97F	10A Mains Relay	£1.65
YX98G	5A Mains Relay	£3.20

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YX99H	12V 30A Relay	£2.15
FX23A	Open Relay 6V	£3.25
FX24B	Open Relay 12V	£3.88
FX26D	2p Sub Min Relay 6V	£3.45
FX27E	2p Sub Min Relay 12V	£3.45
FX28F	2p Sub-Min Relay 24V	DIS
FX30H	4p Sub-Min Relay 12V	£3.95

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HY20W	Relay Flat 12V	£2.43
FX48C	Power Relay 12V	£3.95
FX49D	Power Relay 230V AC	£4.25
YB89W	Car Relay Single	DIS
FX50E	Reed Relay 6 to 9V	£1.98
FX51F	Reed Relay 9 to 12V	£2.15
FX73Q	Reed Relay 12 to 18V	£2.15
FX74R	Reed Relay 18 to 30V	£2.95

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FX88V	Dil Reed Relay 1p 5V	£1.95
FX89W	Dil Reed Relay 1p12V	£2.15
FX90X	Dil Reed Relay 2p 5V	£3.99
FX91Y	Dil Reed Relay 2p12V	£3.85
FX92A	Dil Rd Relay 1pC/05V	£8.25
FX93B	Dil Rd Rly 1p C/O12V	£8.39
FX68Y	Reed SW Standard	89p
FX69A	Reed SW Compact	£1.75
FX70M	Reed SW Miniature	69p
FX71N	Magnet Small	38p
FX72P	Magnet Large	88p
HB13P	Sw Former Stan One	DIS
HB17T	Sw Former Min One	DIS
HB15R	Sw Former Comp One	75p

TEST GEAR

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HF19V	Test Prod Black	45p
HF20W	Test Prod Red	45p
YX57M	Min Probe Black	38p
YX58N	Min Probe Blue	38p
YX59P	Min Probe Green	38p
YX60Q	Min Probe Red	38p
YX61R	Min Probe Yellow	38p
HF21X	Probe Clips	89p
HF30H	Pistol Probe Black	99p
HF31J	Pistol Probe Red	99p
HF22Y	Lo-Cost Test Probe	74p
HF32K	Moulded Test Probe	79p
HF33L	4mm Test Probe	89p
YR94C	AVO-type Test Lead	£4.45
YR93B	Test Lead Kit	£2.75
FY73Q	Logic Probe	£9.50

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FY88V	Continuity Probe	99p
FL61R	Signal Injector	£5.99
BW05F	Scope Probe BNC	£15.63
BR89W	Scope Probe 4mm	£16.25
FY74R	IC Test Clip	£2.35■
YB21X	Safebloc	£7.50
YR95D	Lo-Cost Scope Probe	£3.75

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XB82D	Calscope Super 6	DIS
	Carr in UK with XB82	DIS
•XB83E	Scopex 14D-10	£286.00
	Carr in UK with XB83	£9.45

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XY05F	500MHz Freqncy Cntr	£115.95
LH05F	Transistor Testr HFE	£15.20
YB82D	LCR Bridge	£25.30
YB81C	Seesure Sig Gen	£26.75
YW93B	Low Cost Multimeter	£4.85
FL60Q	Pocket Multimeter	£7.50

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YB83E	Small Multimeter	£15.95
YW68Y	Multimeter Type 320	£16.25
LH93B	Taut-Band Multimeter	£23.95
YB87U	100K Multitester	£44.00

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YB84F	Microtest 80	£19.09
YB85G	Supertester 680G	£28.96
YB86T	Supertester 680R	£37.80

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LH80B	Clamp Meter	£26.90
LH94C	DMM 200	£47.50
LH95D	DMM 100	£88.61

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YL12N	HV Probe	£8.91
YL13P	Shunt 25A	£8.91
YL14Q	Shunt 100A	£8.91
XY75S	Ham Multimeter	£31.95
WY18U	SWR Meter 310	£10.75

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WY19V	SWR Meter 110	£14.75
WY20W	Transtest UH74	£19.75
WY21X	SWR Meter 178	£24.95
YB04E	Grid Dip Meter	£45.00

TOOLS

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LH15R	Hobby Box	£3.45
FR22Y	Storage Drawer	95p

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BR48C	Hex Trimmer	24p
BR51F	Trim Tool	45p
BR49D	Preset Trimmer	68p
BR50E	Trim TT5	60p
FY07H	Min Screwdriver Set	85p
BR58N	Jewllers Scrwdvr Set	£2.30
BR79L	Intrchgbl Scdrvr Set	£1.69
YW60Q	Min Tool Set	£2.10
FY08J	Utility Set	£4.49

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YX74R	Min Screwdriver	10p
BR52G	Small Screwdriver	34p
BR53H	Large Screwdriver	36p
YG24B	Driver S2	16p
FY10L	Driver S3	26p
FY12N	Driver S5	89p■
FY13P	Driver S6	63p
FY15R	Pozidriver P1	73p
FY17T	Pozidriver P2	99p
BR71N	Mains Tester	60p
LH75S	Spiraldriver	£4.25
YW92A	Ratchet Socket Set	£5.99
WY04E	Cushiongrip Drvr Set	£5.25
FY19V	Low Cost Min Cutters	£4.25
BR75S	Ins Min Cutters	£6.93

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BR70M	Box-Joint Min Cutter	DIS
FY20W	Box-JT End Cutter	£5.60
FY21X	Low-Cost Cutters	£2.25
FY76H	Large Low Cost Cutts	£3.75
BR74R	Side Cutters	£5.95
FY22Y	Box Jt Side Cutters	£7.60
BR72P	Side Cutters S55	£4.50
FY23A	High Leverage Cutter	DIS
YW67X	Tweezers	19p
FY24B	Low Cost Min Pliers	£3.90■
BR78K	Ins Min Snipe	£5.45
BR69A	Box Joint Min Pliers	£8.60
BR77J	Bright Pliers	£4.55
FY25C	Low-Cost Pliers	£1.95
FY26D	Box Combined Pliers	£3.99

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FY27E	Low-Cost Long Pliers	£3.99
BR92A	Combination Pliers	£5.50
BR73Q	Long Snipe Pliers	£7.49
BR90X	Box Radio Pliers	£6.37
FY28F	Low-Cost Elec Pliers	£2.85
FY29G	Low-Cost HD Pliers	£2.45
BR91Y	Electricians Pliers	£4.90
FY30H	Pincers	£3.37
•FY31J	Crimp Tool	£2.15
BR76H	End Action Strippers	£5.99
BR93B	Wire Strippers 3A	£2.35
BR94C	Wire Strippers 8B	£1.49
BR95D	Wire Strippers 9	£3.96
BR96E	Stripmaster	£16.25
BR97F	Blade L5361	£6.20
XX11M	Blade L4421	£5.70

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FY32K	Hand Wrap Tool	£6.48
HY16S	Verowire Pen	£4.49
HY17T	Verowire Spool	99p
FY33L	Verowire Comb	8p
FY34M	Allen Keys AF	£1.45
FY35Q	Allen Keys Metric	£1.35
YR82D	Min Spanner Set	£2.10
FY36P	Min Spanner 24	£1.15
FY37S	Min Spanner 68	£1.15
FY38R	Ring Spanner 02	£1.99
FY39N	Ring Spanner 46	£1.69
YW61R	Box Spanner Set	£2.15
YW62S	PSD6 Spanner Set	£4.75
FY45Y	Crescent Wrench 160	£3.35
FY46A	Crescent Wrench 210	£4.20

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FY40T	Box Spanner 2BA	£1.25
FY41U	Box Spanner 4BA	£1.25
FY42V	Box Spanner 6BA	£1.25
FY43W	Box Spanner 8BA	£1.25
FY44X	Quick Grips	DIS
FY47B	Adjustable Wrench	£3.20
•YW63T	Needle File Set	£5.60
FY49D	Needle File Flat Wrd	£1.53
FY50E	Needle File Hand	£1.75
FY51F	Needle File Halfrnd	£1.63
FY52G	Needle File Round	£2.27
BR63T	Junior Hacksaw	99p
BR64U	6in Hacksaw Blades	79p
FY54J	Wire Brush	45p
FY55K	Wet & Dry Fine	18p
FY56L	Wet & Dry Med	19p
FY57M	Wet & Dry Course	25p
HX04E	Polish Block	£1.40
FY02C	Utility Knife	£1.60
FY03D	Retractable Knife	£1.99
FY04E	Knife Blades	99p
YW64U	Snap-Off Blade Knife	99p

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FY05F	Scalpel Handle	£1.75
FY06G	Scalpel Bld Type II	46p
BR59P	Punch 3/8in	£4.15
BR60Q	Punch 7/16in	£4.29
BR61R	Punch 1/2in	£4.35
BR62S	Punch 9/16in	£4.49
BR80B	Punch 5/8in	£4.45
BR81C	Punch 3/4in	£4.25■
BR83E	Punch 1in	£5.20
BW00A	Punch 1 1/2in	£6.49
FY53H	Mini Vice	£3.45
LH79L	Reliant Kit	£21.95
BW03D	Reliant Drill	£7.60
BW02C	Titan Drill	£11.25
YW65V	Mini Mains Drill	£14.25
XB12N	Drill Stand	£14.95
BR84F	Reliant Collar	75p
BW04E	Drill Power Supply	£13.99

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BR65V	Twist Burr 0.8mm	43p
BR66W	Twist Burr 1.4mm	43p
BR85G	HS Twist Drill 0.8mm	75p
BR86T	HS Twist Drill 1mm	75p
BR87U	HS Twist Drill 1.4mm	75p
YY28F	Long-Life Drill 1mm	£1.20
LH77J	20-Piece Tool Kit	£8.25
LH78K	40-Piece Tool Kit	£14.95

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FY62S	Iron CX	£5.95
FY63T	Element CX	£2.75
FR30H	Bit 6/1106	89p
FY64U	Bit 1100	84p
FY65V	Bit 1101	84p
FR31J	Bit 7/1101	£1.21
FY66W	Bit 1102	90p
FY67X	Bit 1103	88p
FR01B	Element Type CN	£2.65
FR02C	Handle Type CN	85p
FR03D	Bit 102	84p
FR04E	Bit 104	88p
FR05F	Bit 106	84p
FR06G	Bit 820	84p
FR07H	Bit 821	84p
FR08J	Bit 822	84p
FR12N	Iron X25	£5.95
FR13P	12V Iron MLX12	£7.20
FR14Q	Element X25	£2.75
FR15R	Element MLX12	£2.45
FR16S	Bit No. 50	84p
FR17T	Bit No. 51	84p
FR18U	Bit No. 52	84p
FR20W	Stand ST3	£2.95
FR11M	Sponge	11p
FY68Y	Kit SK3	£8.45

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FY69A	Kit SK4	£8.45
WY05F	Rechargeable Iron	£26.95
YX67X	B50 Bit Round	£2.95
YX68Y	B50 Bit Angled	£3.45
YX69A	B50 Bit Flattened	£3.65
YX70M	B50 Lamp	85p
YX71N	B50 Holder	62p
YX72P	B50 Sponge	29p
FR10L	Heat Sink Tweezers	19p
FR23A	Solder Sucker	£4.50
FR24B	Sucker Tiplet	£1.55
FR26D	Desolder Tool	£7.25
HY13P	Desldr Nozzle Type 2	89p
FR63T	Desldr Washer Type 2	24p
FR27E	Desolder Washer	DIS
FR28F	Desolder Nozzle	£1.55
FR29G	Solda-Mop	90p
FR21X	Solder D622	75p
FY70M	1/2kg Reel Solder	£10.85
FY71N	Alum Solder 1m Pk	43p

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FY72P	Conductive Paint	£5.35
LH04E	Freeze-it	£1.75
LH03D	Switch Cleaner	£1.82
YB77J	Servisol	£1.66
LH02C	Aero-Klene	£1.55
YB73Q	Aero-Duster	£1.75
YB74R	Silicone Grease	£1.98
YB75S	Plastic Seal	£1.55
YB76H	Foam Cleanser	£2.35
YB78K	Excel Polish	£1.70
YB79L	Anti-Static Spray	£1.45
YB80B	Fire Extinguisher	£4.85
FL43W	Evostik Impact	99p

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FL46A	Cyanoacrylate	£1.55
LQ02C	Potting Compound	£3.55
FL44X	Araldite Rapid	£2.25
FL45Y	Double Bubble Sachet	25p
FL47B	PVC Tape Black	35p
FL48C	PVC Tape Blue	35p
FL49D	PVC Tape Brown	35p
FL50E	PVC Tape Green	35p
FL51F	PVC Tape Red	35p
FL52G	PVC Tape White	35p
YR99H	PVC Tape Yellow	35p

WOUND PARTS

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LB40T	9.5 Coil Former	60p
LB17T	Former 351	24p
LB18U	Former 450	16p
LB19V	Former 722/1	13p
LB20W	Former 722/2	13p
LB21X	Former 722/8	13p
LB22Y	Former 722/4	13p
LB41U	Dust Core Type 4	10p
LB42V	Dust Core Type 6	11p
LB43W	Dust Core Type 8	17p
LB44X	Former Base	12p
LB36P	Screening Can 10	10p
LB37S	Screening Can 13	DIS
LB39N	Screening Can 15	14p
LB38R	Screening Can 14	DIS
LB62S	A/P Beads	35p
HX05F	Small Pot Core	£1.30
HX06G	Core Type 2	£1.45
LH76H	Wishbone Sharpener	£6.85
YW66W	Pin Drill	£4.95
HQ02C	HS Drill 1/16in	19p
HQ03D	HS Drill 5/64in	23p
HQ04E	HS Drill 3/32in	26p
HQ05F	HS Drill 7/64in	28p
HQ06G	HS Drill 1/8in	29p
HQ07H	HS Drill 9/64in	35p
HQ08J	HS Drill 5/32in	41p
HQ09K	HS Drill 11/64in	45p
HQ10L	HS Drill 3/16in	50p
HQ11M	HS Drill 13/64in	56p
HQ12N	HS Drill 7/32in	60p
HQ13P	HS Drill 15/64in	68p
HQ14Q	HS Drill 1/4in	75p
HQ15R	HS Drill 17/64in	89p
HQ16S	HS Drill 9/32in	96p
HQ17T	HS Drill 19/64in	£1.05
HQ18U	HS Drill 5/16in	£1.15
HQ19V	HS Drill 21/64in	£1.22
HQ20W	HS Drill 11/32in	£1.32
HQ21X	HS Drill 23/64in	£1.48
HQ22Y	HS Drill 3/8in	£1.49
HQ23A	HS Drill 25/64in	£1.55
HQ24B	HS Drill 13/32in	DIS
HQ25C	HS Drill 27/64in	£1.95
HQ26D	HS Drill 7/16in	£2.17
HQ27E	HS Drill 29/64in	£2.35
HQ28F	HS Drill 15/32in	£2.45
HQ29G	HS Drill 1/2in	£2.75
FY58N	Round Tape Rule	DIS
FY59P	Retractable Rule	£2.75
FY60Q	Feeler Gauge Imp	95p
FY61R	Feeler Gauge Metric	97p

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HX07H	Bobbin Type 2	75p
HX08J	Clips Type 2	5p
HX09K	Type 3 Core	£1.85
HX10L	Type 3 Bobbin	42p
HX11M	Type 3 Clips	6p
HX12N	Large Pot Core	99p
HX13P	Bobbin Type 4	10p
HX14Q	Mtg System Type 4	89p
HW23A	GE Coil L15	£1.95
HX58N	GE Coil L9	£2.20
HX57M	GE Coil L8	£2.20
HW24B	GE Coil L14	£1.95
HX56L	GE Coil L7	£2.20
HX55K	GE Coil L6	£2.20
HX54J	GE Coil L5	£2.25
HW25C	GE Coil L12	£1.99
HW26D	GE Coil L11	£1.99

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HX24B	Choke 0.5H	£1.15
HX25C	Choke 1H	£1.15
HX26D	Choke 2H	£1.15
HX27E	Choke 4H	£1.15
LR07H	Filter Pot Core	£2.15
XX30H	Equaliser Pot Core	£1.99
HW27E	Choke 10H	£1.55
HW28F	Choke 5uH HC	48p
HX15R	Choke 1.5mH	48p
HX16S	Choke 2.5mH	54p
HX17T	Choke 5mH	54p
HX18U	Choke 7.5mH	66p
HX19V	Choke 10mH	29p
HX22Y	Choke RFC5	£2.10
HX23A	Choke RFC9A	£2.20
WH25C	Choke 0.22uH	48p
WH27E	Choke 0.47uH	53p
WH29G	Choke 1.0uH	45p
WH30H	Choke 1.5uH	45p
WH31J	Choke 2.2uH	45p
WH32K	Choke 3.3uH	45p
WH33L	Choke 4.7uH	49p
WH34M	Choke 6.8uH	55p
WH35Q	Choke 10.0uH	45p
WH36P	Choke 15.0uH	61p
WH37S	Choke 22.0uH	48p
WH38R	Choke 33.0uH	48p
WH39N	Choke 47.0uH	48p
WH41U	Choke 100uH	54p
WH45Y	Choke 470uH	55p
WH47B	Choke 1mH	75p
HX29G	Crystl Set Coil PCC1	£1.95

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HX42V	Toko YRCS 11098	46p
YG30H	Toko YRCS12374	44p
HX43W	Toko YHCS 11100	46p
YG31J	Toko CSK3464	47p
YG32K	Toko YMCS17104	47p
HX97F	Toko ACS 34342	59p
HX98G	Toko ACS 34343	46p
YG39N	Toko KAC8448	48p
YG36P	Toko KAC8449	46p
LB00A	IFT 13	£1.48
LB01B	IFT 14	£1.75
LB03D	IFT 16	£1.72
LB04E	IFT 17	£1.75
LB02C	IFT 15	£1.81
LB05F	IFT 18 465kHz	£2.19
LB06G	IFT 18 1.6MHz	£1.68
HX28F	Toc 1	£1.99
HX69A	Trans Coil 1T Blue	£2.57
HX70M	Trans Coil 1T Red	£2.17
HX71N	Trans Coil 1T White	£2.95
HX72P	Trans Coil 1T Yellow	£2.26
HX73Q	Trans Coil 2T Blue	£2.17
HX74R	Trans Coil 2T Red	£2.20
HX75S	Trans Coil 2T White	£1.48
HX76H	Trans Coil 2T Yellow	£1.88
HX77J	Trans Coil 3T Blue	£2.17
HX78K	Trans Coil 3T Red	£2.17
HX79L	Trans Coil 3T White	£2.17
HX80B	Trans Coil 3T Yellow	£2.20
HX89W	Trans Coil 4T Blue	£2.17
HX90X	Trnas Coil 4T Red	£2.17
HX91Y	Trans Coil 4T White	£2.45
HX92A	Trans Coil 4T Yellow	£2.20
HX93B	Trans Coil 5T Blue	£1.70
HX94C	Trans Coil 5T Red	£2.17
HX95D	Trans Coil 5T White	£2.11
HX96E	Trans Coil 5T Yellow	£2.16

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HX82D	Min Tr LT44	55p
LB14Q	Min Tr LT700	55p
YR91Y	Min Tr LT800	33p
WB00A	Sub-Min Tr 6V	£1.30
WB01B	Sub-Min Tr 9V	£1.30
WB02C	Sub-Min Tr 12V	£1.40
WB06G	Min Tr 6V	£3.30
WB11M	Min Tr 9V	£4.25
WB10L	Min Tr 12V	£3.35
WB15R	Min Tr 15V	£3.35
LY03D	Tr 10VA 15V	£4.95
WB16S	Min Tr 20V	£3.35
WB20W	Min Tr 24V	£3.35
WB21X	Min Tr 36V	DIS
WB25C	Tr 12V 1A	£6.55
WB26D	Tr 12V 2A	£7.95
WB03D	Tr 9V 1.1/2A	£6.25
WB12N	Tr 20V 1A	£8.25
WB17T	Tr 28V 1.1/2A	£9.95
XB38R	TR 32032/6.1/2A	£23.25
HX59P	Trnsformer Mtg Plate	66p

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WB07H	Tr 34V 1A	£7.85
WB22Y	Tr 34V HP	£8.15
LW34M	15/22V Power Tran	£13.95
LW33L	Tr 240V Isotran	£4.95
HX81C	Pulse Transformer	£3.45
WB28F	Clock Transformer	DIS
YX66W	Line Transformer	£3.35
LB70M	Mic Xformer MX5	DIS
LB71N	Mic Xformer MX6	DIS
LR05F	Mic Xfrm Typ2 20-30R	DIS
LR06G	Mc Xfm Typ2 200-600R	£19.45
YX84F	Z Changer	£7.85

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YG12N	Min Motor	£2.45
YG13P	Small Motor	£1.25
YG14Q	Servo Mechanism	£3.60

NEW ITEMS PRICE LIST

The following is a list of all items introduced prior to this price list, but since publication of our 1981/82 catalogue and includes all special items for projects that appeared in the March 1981 to May 1982 issues of Electronics & Music Maker.

AERIALS, AMATEUR RADIO AND CB

AF46A CB FM Transceiver GT-868	Price £49.95
HL94C 30W Dummy Load	Price £6.75
XG10L 12V 3A Power Unit	Price £16.95
XG13P 1.5m CB Aerial	Price £13.95
YG41U 27MHz Rubber Deck	Price £4.75
YK00A 2m Scanning Receiver	Price £54.95
YK29G Ext CB Speaker	Price £7.45
YK30H Noise Filter System	Price £10.95
YL42V Filter Choke	Price £1.99
YL43W TVI Filter	Price £5.25
YL44X CB Aerial Converter	Price £7.25
YQ73Q CB/Radio Aerial Coupler	Price £5.49
YQ74R CB Aerial Matcher	Price £5.25

BATTERIES

HW31J Nicad PP3	Price £5.95
HW32K PP3 Nicad Charger	Price £6.95
HY32K Large Battery Holder	Price £1.85
YK31J Universal Ni-Cad Charger	Price £8.95

BOOKS, MAGAZINES AND LEAFLETS

GG24B Analog Subscription	Price £9.00*NV*
WG01B Practical Electronics Handbook by Ian Sinclair	Price £4.70*NV*
WG02C Newnes Book of Video by K. G. Jackson	Price £6.90*NV*
WG03D Introduction To Pascal by Rodnay Zaks	Price £10.75*NV*
WG04E A Basic Approach to BASIC by Henry Mullish	Price £9.85*NV*
WG05F Atari BASIC by Albrecht	Price £7.95*NV*
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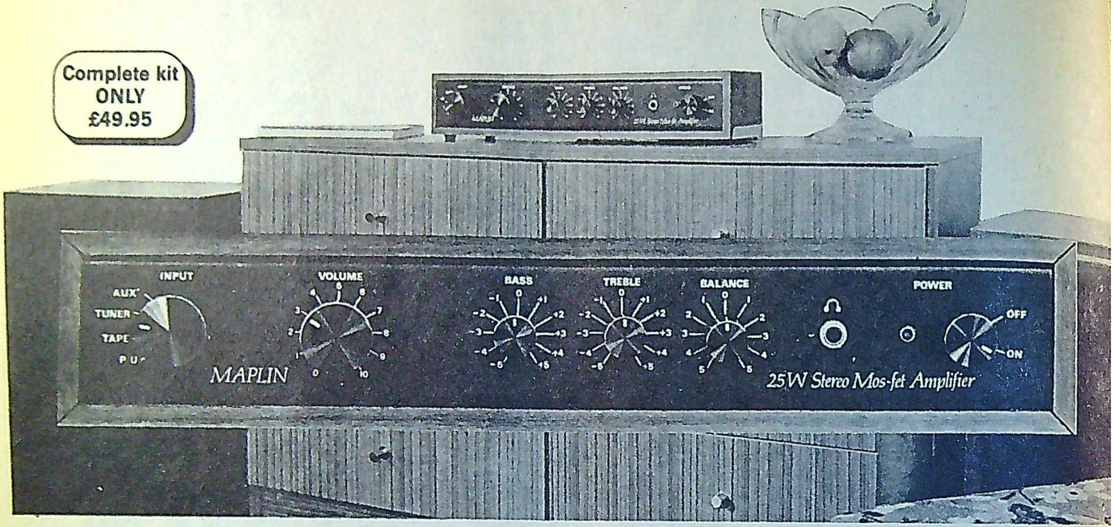
Continued on page 60

25W STEREO MOS~FET HI~FI AMPLIFIER

by Dave Goodman

Complete kit ONLY £49.95



- ★ **25W per channel rms with power MOSFET output**
- ★ **Very easy to build — only 7 interconnecting wires**
- ★ **Extremely low total harmonic distortion**
- ★ **Extremely low noise**
- ★ **High efficiency toroidal transformer**
- ★ **Complete kit includes wooden cabinet & chassis**
- ★ **No setting-up required**
- ★ **All components except 5 mount directly on main pcb**

One of the most popular projects we have ever produced is the MOSFET amplifier described in the June 1981 issue of "Electronics and Music Maker". Its popularity is doubtless due to the virtues of the MOSFET transistors — as the article says: they are "virtually bomb-proof — like the best valve amps." For reliability, freedom from thermal runaway and extremely low harmonic distortion there's nothing to touch the MOSFET transistor for audio power output stages.

As well as offering these essential advantages this stereo amplifier has been carefully designed for absolute ease of construction; this in its turn adding to the reliability and repeatable quality for all constructors. All the components, bar five, mount directly on to the main pcb and only seven interconnecting wires are required and they are for the headphone socket and LED.

The inputs and outputs are on pcb mounting DIN sockets and provision has been made on the pcb for connecting a graphic equaliser, though you will need to drill the rear panel to make connection. Otherwise the kit contains everything you need including a punched chassis finished in matt black with legends printed on the front and rear panels. A wooden cabinet is also supplied which has to be glued together with a woodworker's PVA adhesive (e.g. Resin W) and this glue is not supplied in the kit.

No setting-up is required. If the building instructions are carefully followed then the amplifier will work correctly as soon as it is switched on. However, a preset is provided for each input (except auxiliary) which can be adjusted if desired, so that when switching between inputs, the volume control does not have to be altered to keep the output volume constant. In addition, a remote control unit for volume, bass, treble and balance will be published shortly — hopefully in the next issue.

Circuit Description

T1 is a toroidal transformer and was chosen as it has several advantages over conventional types. It is much more efficient as it runs cooler and has lower radiated magnetic fields keeping stray hum to a minimum. Its small size

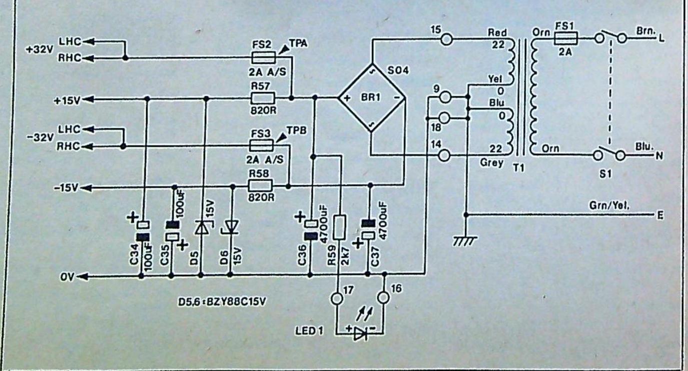


Figure 1. Circuit diagram of power supply.

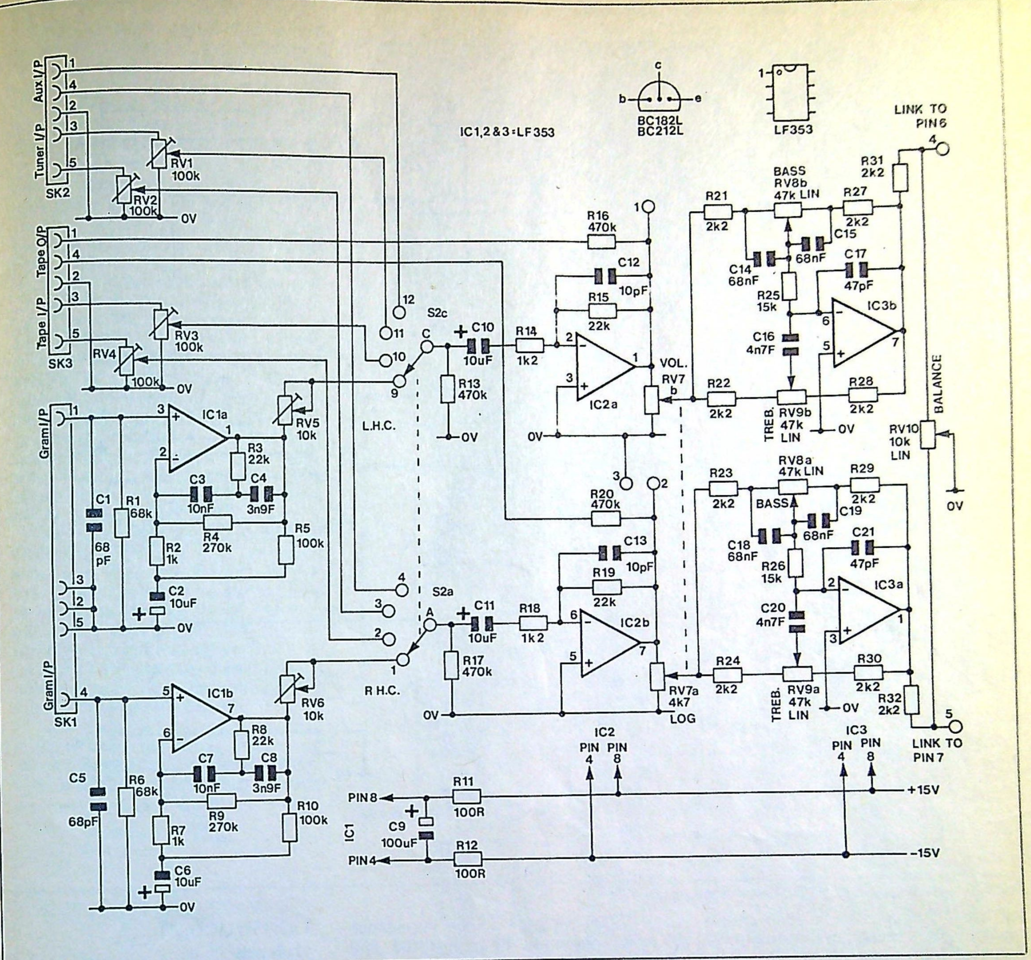


Figure 2. Circuit diagram of pre-amp and tone controls.

Specification of prototype

Input sensitivities for max. output (with preset adjusted for max. sensitivity).

Magnetic pick-up input: 2mV at 47kΩ
Tape input: 50mV at 100kΩ
Tuner input: 50mV at 100kΩ
Auxiliary input: 50mV at 470kΩ
Magnetic pick-up input overload threshold: 40mV
Tape output at rated input: 100mV into 100kΩ
Power output: >26W per channel rms into 8Ω or 4Ω continuous at 1kHz both channels driven.
Total harmonic distortion: Better than 0.075% at 1kHz at >25W output.
Frequency response: 20Hz to 40kHz ±1dB (from magnetic pick-up input ±1dB from RIAA)
Signal to noise: Better than 60dB on magnetic pick-up input
Better than 80dB on all other inputs
Channel separation: Better than 40dB
Bass control: ±14dB boost and cut at 100Hz
Treble control: ±8dB boost and cut at 10kHz
Balance control: -50dB to +1.5dB

also allows the cabinet to be low-profile and it has no open terminals making it intrinsically safer.

The transformer secondary is full-wave rectified by BR1 and smoothed by C36 and C37. The output via fuses FS2 and FS3 deliver ±32V to the MOSFET output stages only, whilst Zener diodes D5 and D6 and resistors R57 and R58 produce ±15V to drive the remainder of the circuitry in the amplifier. IC2 and IC3 are supplied directly from these rails, but IC1 has further decoupling provided by R11, R12 and C9.

IC1a and b is a dual bi-fet op-amp whose non-inverting inputs are suitably matched for use with magnetic cartridges. A degree of protection from stray rf is also provided. The feedback circuitry about each input produces a response to within ±1dB of the recommended RIAA curve. This is achieved by using frequency selective feedback to boost the lower and cut the upper frequencies. Presets RV5 and RV6 control the gain of the pick-up input and allow fine adjustment of channel balance or reduction of volume of high output magnetic cartridges.

RV1 and RV2 perform the same function for the tuner input and RV3 and RV4 for the tape input. If not required simply turn them to the end that gives maximum volume. The auxiliary input level is not presettable, but is selected along with the other inputs by S2. IC2 is a mixer stage supplying the tape output and has an almost perfectly flat response over the audio spectrum.

The volume control, RV7, supplies the selected input signal to IC3 which looks after the tone compensation. RV8 gives boost or cut of the bass frequencies while RV9 controls the gain of

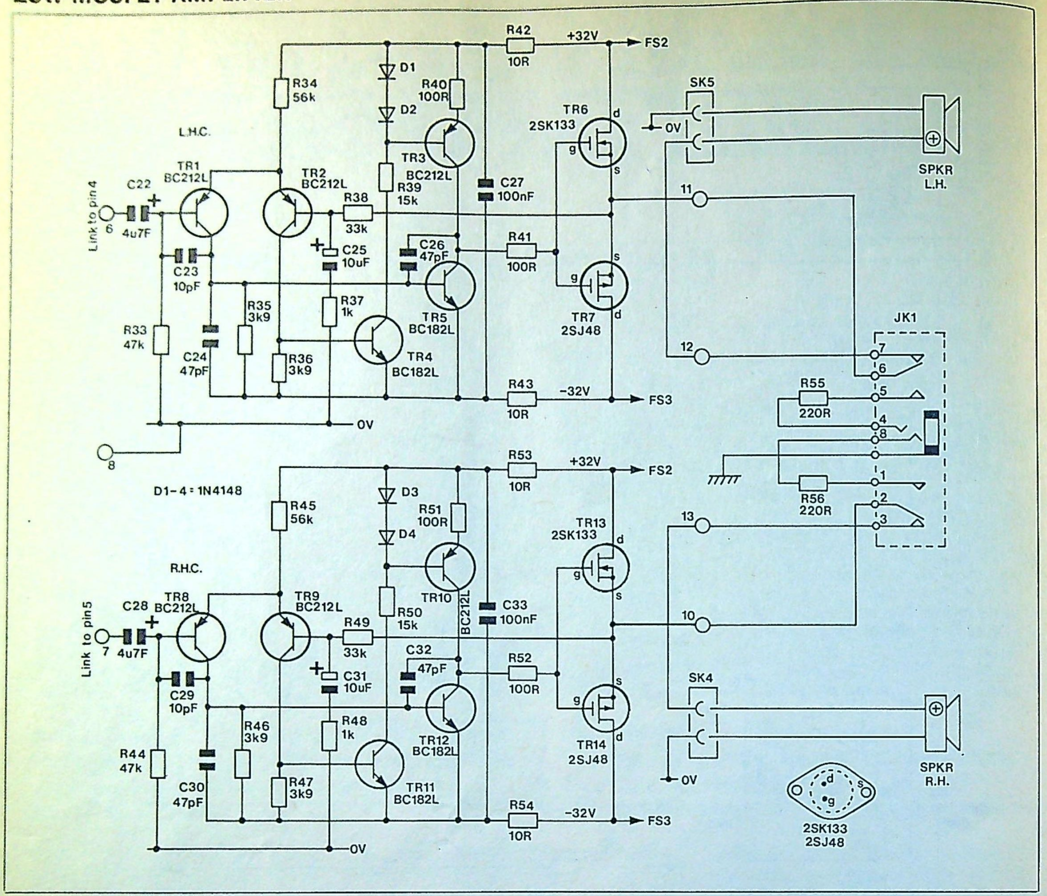


Figure 3. Circuit diagram of MOSFET power amp.

the treble frequencies. In their centre positions, this stage too has an almost perfectly flat response over the audio range. The balance control, RV10, simply shunts the audio signal to ground of the channel it is turned from.

Pins 4 and 5 are strapped to pins 6 and 7, but these straps can be removed if you wish to insert a graphic equaliser.

TR1 and 2 form a differential amplifier whose output is fed to TR5, a voltage amplifier/driver stage. TR3 is a constant current and impedance source which is controlled by TR4. The output of TR5 drives the power MOSFET's TR6 and TR7.

Power MOSFET's have a very low 'on' resistance and an extremely high 'off' resistance and display the characteristic channelling effect when driving into near short-circuits, since the forward resistance increases as the temperature of the device rises, unlike a bipolar transistor, where the opposite effect causes the destruction of the device. The effect allows circuit design to be simple and this in turn improves the distortion and noise figures.

Even further simplicity of design is achieved because the gates of MOSFET's having such a high impedance allows them to be connected and biased together without suffering from cross-over distortion. A small bias voltage is applied from a constant current set to around 20mA, though this is not critical and hence no setting-up is required.

The overall gain of the power amplifier is 33 as set by the ratio of R38 to R37. The power amp has a virtually perfectly flat response over the entire audio range with excellent stability and very fast switching or slew rate which gives an extremely wide power bandwidth, yet the damping factor is still very good.

The output of the power amp is fed to DIN sockets SK4 and SK5 which supply the external speakers, while JK1 disconnects this output and connects it via R55 and R56 to a stereo headphone when a plug is inserted.

The additional pins 1, 2 and 3 have been included so that a remote control unit for volume, bass, treble and balance may be added. Details of this easy-to-construct addition will be published shortly — hopefully in the next edition if space is available.

Construction

Main pcb

With reference to Figure 4 insert the 28 Veropins from the track side, then push them firmly home with the tip of a hot soldering iron and solder to the pcb. Fit the thirteen links using 24 swg tinned copper wire as shown in Figure 4. This Figure also shows how to fit and solder the two straps required between pins 4 and 6 and between pins 5 and 7 and again this should be done with the tinned copper wire and soldered.

Resistors R1 to R54 and R57 to R59 can now be fitted to the pcb. Bend the leads before insertion and push them down on to the pcb. If you cannot read the colour code directly, use the chart in the resistor section of our catalogue or the colour wheel (XL05F). Note that R3, 4, 8 and 9 must be 1% tolerance types and these are either marked 1% or they have a brown ring where the gold ring is found on 5% types.

Next insert the 1N4148 diodes, D1 to D4 and the two Zener diodes D5 and D6. These six diodes have a black band and must be placed on the pcb so that this band is at the same end as the white band printed on the pcb.

RV1 to RV6 are preset potentiometers. Carefully check the values stamped on the wiper: RV1 to RV4 are 100k and RV5 and RV6 are 10k. Fit these to the pcb. By now quite a jungle of leads will be forming beneath the pcb, so solder these in position and cut off all remaining ends close to the joint. It is advisable to check for shorts between tracks and soldered joints after each use of the soldering iron. Excess flux can be removed using cellulose paint thinner and a stiff paint brush, but use the thinners conservatively or a sticky deposit will be formed.

Next fit the ceramic plate capacitors. Their leads do not require bending and should fit straight in. Fit the tantalum bead capacitors C10, 11, 22 and 28 taking care that the '+' sign on the body of the capacitor lines up with the '+' sign printed on the pcb. The little box-shaped capacitors are the polycarbonates and should be fitted next, followed by the polystyrene capacitors whose leads should be pre-formed before fitting to the pcb.

This should also be done to the axial electrolytics C9, 34 and 35 which should be fitted next taking care that the '+' sign printed on the pcb is at the same end as the indentation that runs around the body of the capacitor. The vertically mounted electrolytics C2, 6, 25 and 31 are inserted straight into the pcb and again must be positioned so that the '+' signs are aligned.

Now solder all the components in position, trim the leads, clean and check the pcb as before then mount the three integrated circuits. The small dot

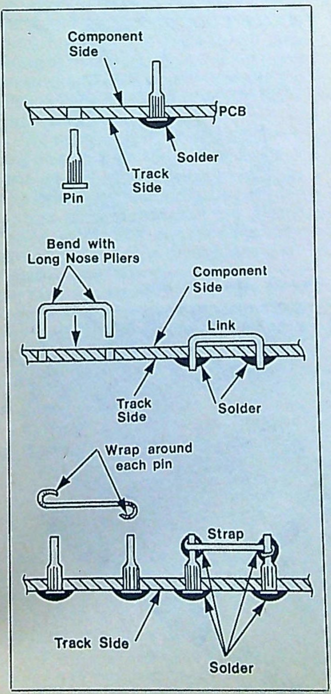
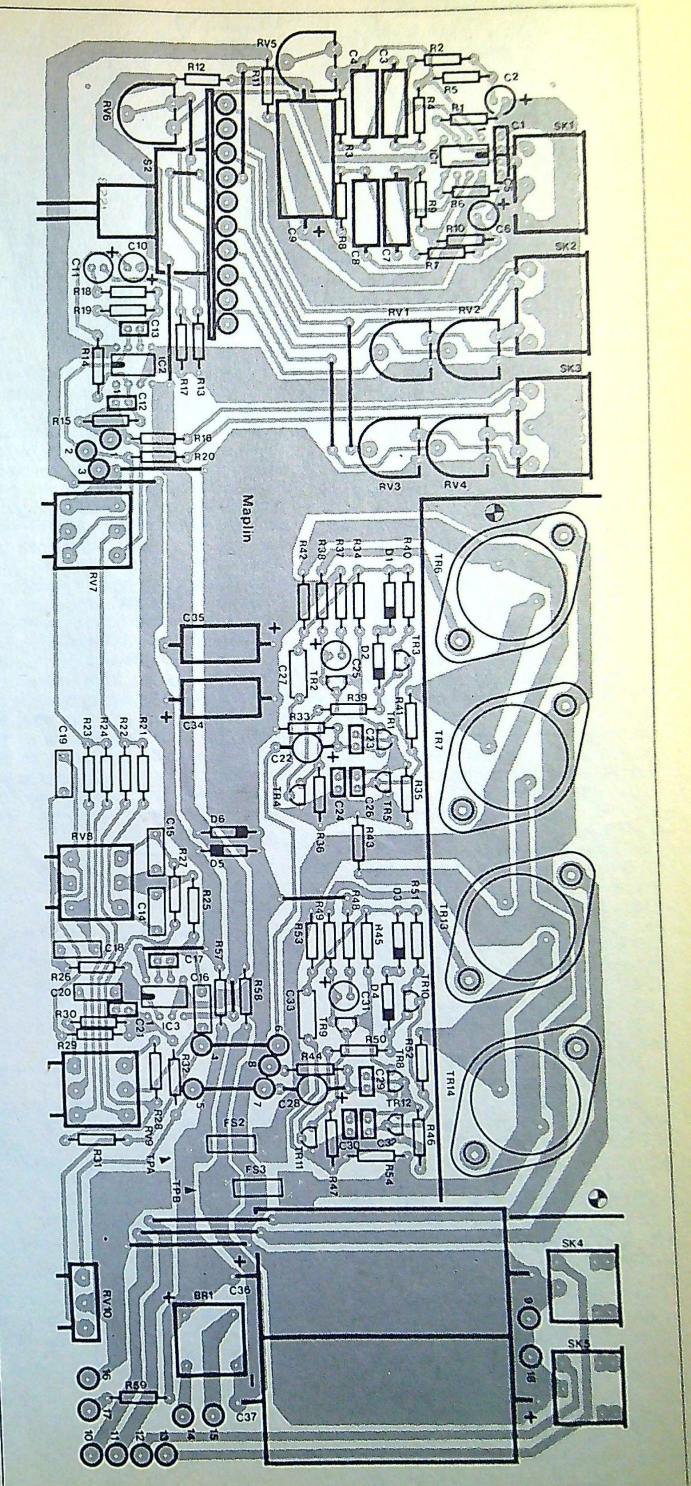


Figure 4. Insertion of pins and links in pcb.



Component overlay of main pcb shown less than full size.

on the top of the IC body indicates pin 1 and should be positioned so that it is at the same end as the 'D' shape formed on the pcb legend. Take care to ensure that all eight leads fit through the pcb on each IC.

Next, fit the bridge rectifier BR1. One edge of the plastic package has a '+' sign painted on it and as before this must be positioned to align with the '+' sign on the pcb. Push the plastic body right down onto the pcb.

Transistors TR1 to TR3 and TR8 to TR10 are type BC212L and their 'D' shaped package must line up with the pcb legend. The same applies to TR4, 5, 11 and 12 which are type BC182L. Push all these transistors down to about 0.5 to 1cm (¼in) from the pcb otherwise they can be easily bent or broken. Fit the two polyester capacitors C27 and C33. These are usually colour coded and from the top the colours are brown, black, yellow, black or white, red or yellow. Now solder all these components as before.

Place the FET mounting bracket over the pcb on the component side and bolt in position with two nuts, washers and 6BA ¼in bolts inserted from the track side. Ensure that the top of the bracket is perfectly smooth and clean. Carefully adjust the position of the bracket so that 16 holes (4 per FET) in the pcb are exactly centralised under the holes in the bracket, and then tighten the bolts. This operation is very important as misalignment will result in a short circuit between the FET and the bracket (0V). One bolt passes through a large area of track and to ensure that there is a good connection between this track (0V) and the bracket, solder the bolt head to the track.

Smear a thin layer of Thermpath over both sides of a mica insulator and place it on one of the power FET's then repeat with the other three. Place each FET with its insulator over the mounting bracket noting that the two leads on the 2SK133's are towards the rear of the pcb (the bracket itself is on the rear edge) and on the 2SJ48's they mount towards the front.

With reference to Figure 5 insert two 6BA ½in bolts from the track side up through each MOSFET and tighten up with 6BA washers and nuts. Solder the FET leads to the pcb and then solder all eight bolt heads to the pcb.

The four small fuseholder clips may now be fitted. The easiest way to do this is to clip a fuse between each pair and then place and solder the whole assembly to the pcb. Remove the fuses when this is completed.

Fit the three 5-pin DIN sockets, SK1 to SK3, ensuring that all seven pins (2 are securing pins) go through the pcb and none are left bent underneath. Sockets SK4 and SK5 should be fitted in the same way. The last two axial electrolytic capacitors C36 and C37 can now be fitted. They mount with polarities in opposite directions so take care to ensure that the indentation around the body is at the same end as the '+' sign on the pcb. Solder these last seven items to the pcb.

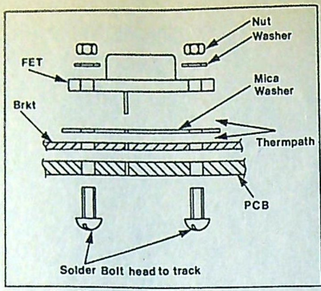


Figure 5. Mounting the MOSFET transistors.

The four-way rotary switch S2 has to be prepared before it can be mounted. Firstly, straighten all fifteen tags on the back of the switch then cut off the tags marked B, 5, 6, 7 and 8 close to the plastic moulding. Secondly, cut off the loops on the ends of the remaining ten tags leaving as much straight pin as possible. Refer to Figure 6. The switch can now be fitted to the small pcb ensuring that all ten pins have come through and solder them in position.

On the main pcb there are ten Veropins situated near the front left side of the board. Lightly tin these pins with a soldering iron (i.e. cover each pin with a *thin* layer of solder). With reference to Figure 7, place S2 facing towards the front of the main pcb and offer the switch pcb up to the ten pins so that they align with the ten tracks on that pcb. Hold the board as upright as you can and solder one pin. Resolder if the board is not perfectly upright, then when satisfied, solder the remaining nine pins.

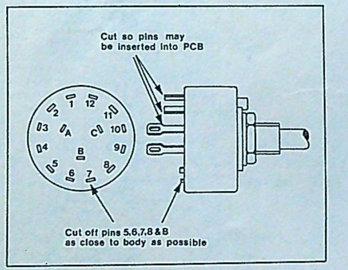

Cut so pins may be inserted into PCB
1
2
3
4
5
6
7
8
9
10
11
12
A
B
C
Cut off pins 5,6,7,8 & B as close to body as possible

Figure 6. Preparing switch S2.

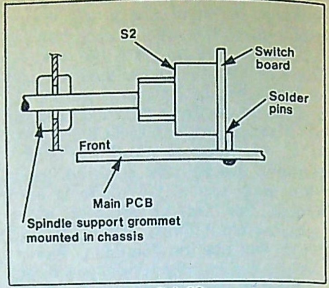


Figure 7. Mounting switch S2.

Finally, mount the four rotary potentiometers on the pcb checking the resistance values against the RV numbers to ensure correct placement, before soldering. The pcb is now complete and should be cleaned up. Re-check all components for correct values and correct orientation of polarised components. Check for dry joints and short circuits and carefully resolder any suspect joints.

If you possess a multimeter, check for short circuits between the pins and case of the MOSFET transistors and the mounting bracket. Switch to ohms and with one lead on the bracket check each lead and case in turn. If there are any short circuits then you will have to strip down the mounting bracket to find out why, but careful construction should have prevented this.

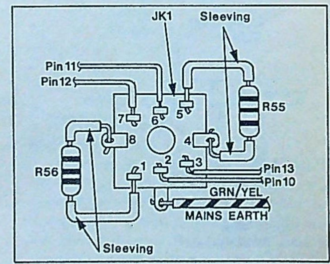
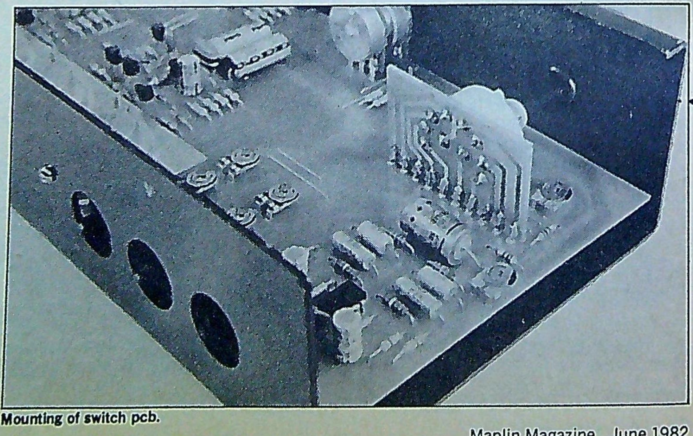


Figure 8. Jack socket wiring.



Mounting of switch pcb.

Assembly

Cut the four potentiometer spindles so that they are about 13mm (½in) long. Remove the nuts and washers from RV8 and RV9 but leave them on RV7 and RV10 and tighten up these two. Fit a grommet into the selector switch hole in the front panel, then slide the pcb into the chassis by guiding the control spindles in first, then lowering into position.

Bolt the mounting bracket to the back of the chassis using three 6BA ¼in bolts and nuts, two washers and a solder tag with the bolts inserted from the outside. The tag washer fits on the bolt nearest to the two 2-pin speaker sockets. The two remaining pot mounting washers and nuts fit onto RV7 and RV10 and tighten up on to the chassis. Make sure that all five DIN sockets line up with the holes in the chassis and readjust to suit.

With reference to Figure 8 slide a piece of sleeving over each wire on R55 and R56 then solder them between tags 4 and 5 and tags 1 and 8 of the jack socket. Cut four pieces of wire each 125mm long, and strip and tin a short length at each end of each piece. Solder these four wires to tags 2, 3, 6 and 7 on the jack socket. Fix the jack socket to the front panel then connect the four wires to the pcb as follows:

JK1 tag	to	pcb pin
2		10
3		13
6		11
7		12

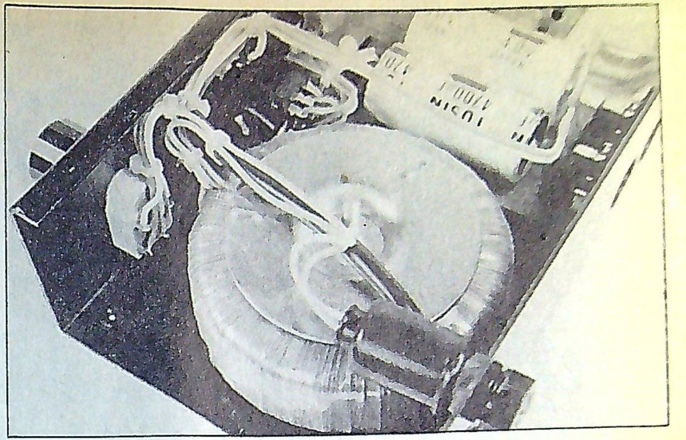
Keep all wiring as short as possible and neatly laid out. Thin wire or cable ties could be used to hold groups of wires together, but there is so little wiring in this project that it is not really necessary and no problems should be encountered. Figure 9 shows the complete wiring arrangements.

Cut two pieces of wire each 150mm long and strip and tin a short length at each end of each piece. Connect one wire to each lead on LED1. A tiny '+' and '–' sign is stamped into the plastic beside each lead, but for those who cannot see them the thicker lead is the negative and the thinner lead is the positive. See Figure 10. Fit the LED in the chassis next to the headphone socket and connect the two wires to the pcb as follows:

LED1	to	pcb pin
+ (thin)		17
- (thick)		16

Now mount the toroidal transformer T1 as shown in Figure 11. Insert the bolt (supplied with the transformer) from under the chassis base through the hole in the indent. Place one of the two rubber washers over the bolt, then the transformer with the wires uppermost. Put the remaining rubber washer on top followed by the clamping plate. Tighten in position with the nut and washer supplied with the transformer.

Carefully scrape the enamel coating off a short length of the end of each of the transformer's six wires. This can be



Interwiring in chassis.

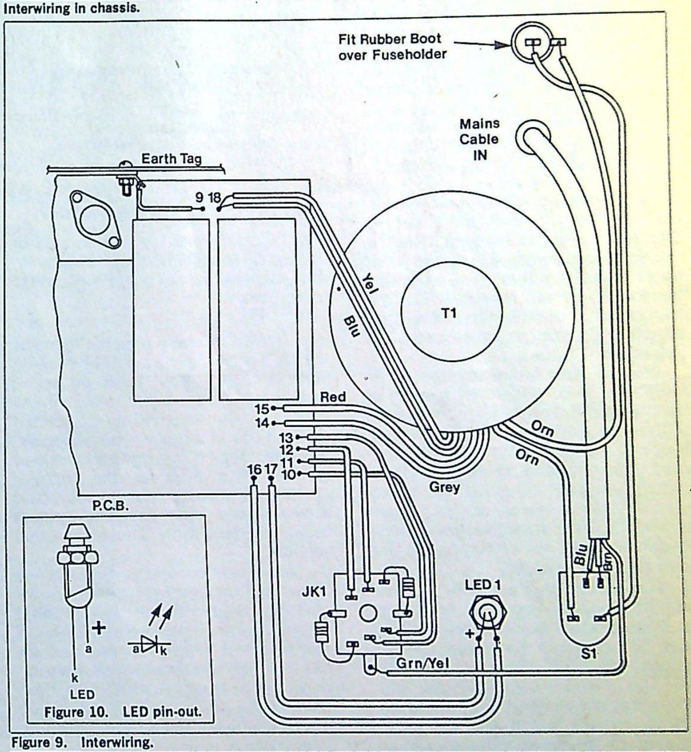
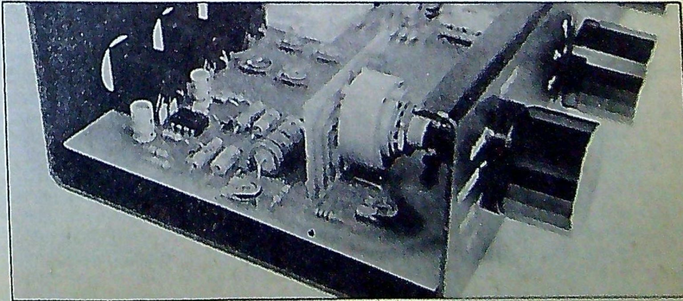
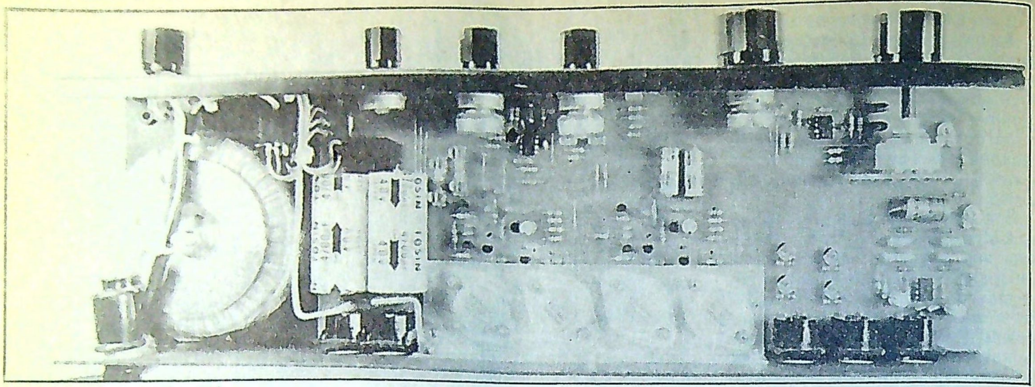


Figure 10. LED pin-out.

Figure 9. Interwiring.



Switch pcb front view.



Internal view of completed amplifier.

done with a sharp knife or a piece of fine emery cloth or wet and dry. Twist together the blue and yellow wires and connect both to pin 18 on the pcb. Connect a short length of wire between pin 9 and the earth tag as shown in Figure 9. Form the red and grey wires around to the bridge rectifier and solder on to pins 14 and 15 on the pcb. It makes no difference which wire goes to which pin.

Fix the chassis fuseholder to the rear panel above T1 and fit a rubber grommet in the hole beneath it. Fix the rotary mains switch S1 to the front panel taking care that the small spigot fits into the matching hole. Cut the spindle to the same length as the other spindles. Also trim the spindle on S2 to this length.

Connect one of the orange wires from T1 (it doesn't matter which one) to the side tag on the fuseholder FS1, after sliding the rubber boot over the wire first. Cut a piece of wire about 150mm (6in) long, strip and tin each end then pass it through the rubber boot and connect it to the rear tag on FS1. Solder both wires, then push the rubber boot forward so that it completely covers the body of the fuseholder.

Connect the other end of this wire to one of the top two terminals on switch S1. Then connect the other orange wire from T1 to the other top terminal on S1. Strip 80mm (3in) of the outer covering of the piece of mains lead and strip and tin a short length of each of the three internal wires. Put the mains lead through the grommet in the rear panel and terminate the blue wire to the tag on S1 immediately below the orange wire from T1 and terminate the brown wire to the tag on S1 immediately below the piece of wire from FS1.

The mains earth (green and yellow wire) should be connected to the earthing tag on the top of JK1. Ensure that all the connections you have made are properly soldered. Check carefully for dry joints and short circuits. Insert the 2A antisurge fuse into FS1 and ensure that the other two fuses are NOT inserted into their clips on the main pcb. Fit the control knobs on to the spindles as shown in the photographs.

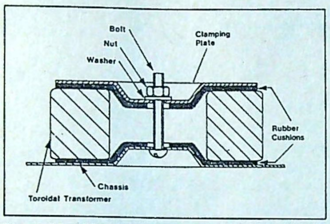


Figure 11. Mounting the toroidal transformer.

Finally check that the last section of wiring is identical to all the diagrams. The amplifier is now ready for testing.

Testing

Fit the 13A mains plug to the mains cable. The rear of S1 could be covered with insulating tape if desired and it would then be quite safe to work in the amplifier with the mains connected without risk of a shock. On no account, however, should children or untrained persons be allowed near the amplifier in this condition. Little fingers could easily unpeel your carefully applied insulating tape with potentially lethal results.

Do not connect any loudspeakers or inputs at this stage and fuses FS2 and 3 must not be fitted. Set all the front panel controls fully anticlockwise. Adjust presets RV5 and RV6 to half-way and set RV1, 2, 3 and 4 fully clockwise. Give the project a final visual inspection then connect the mains plug to the mains and switch the amplifier on by turning S1 clockwise.

LED1 should light up. If it does not switch off, remove the mains and check fuse FS1. If it is still intact, try reversing the wires on pins 16 and 17 on the pcb. Switch on again. If all is well switch a multimeter to 50V DC or 100V DC or thereabouts, connect the negative lead to the metal chassis or the tag on the top of JK1 and the positive lead to pin TPA on the pcb. The meter should read around +32V (±5V). Now put the meter's positive lead to the chassis and connect the negative lead to pin TPB on the pcb. Again the meter should read the same voltage as before i.e. -32V (±5V).

Switch off. If all is well the other two 2A fuses can now be fitted into the fuse clips on the pcb. If desired and you have sufficient knowledge, two further checks can be made. The +15V rails can be checked on D5 and D6 and you should obtain a reading of above 100mV DC between the cases of the four power MOSFET's and the chassis.

The treble, bass and balance controls can now be set centrally. Speakers may now be connected and inputs as required. The input connections are as follows:—

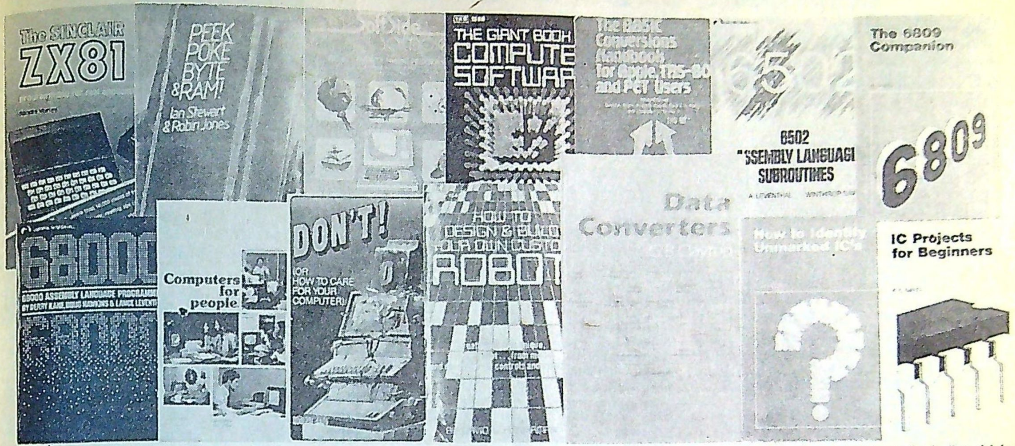
SK1 Magnetic pick-up input (5-pin DIN 180°)
Pin 1 Left channel input
Pin 4 Right channel input
Pins 2, 3, 5 Common (0V)
SK2 Tuner/Aux input (5-pin DIN 180°)
Pin 1 Auxiliary left channel input
Pin 4 Auxiliary right channel input
Pin 3 Tuner left channel input
Pin 5 Tuner right channel input
Pin 2 Common (0V)
SK3 Tape input/output (5-pin DIN 180°)
Pin 1 Tape left channel output
Pin 4 Tape right channel output
Pin 3 Tape left channel input
Pin 5 Tape right channel input
Pin 2 Common (0V)

If when any particular input is selected there is an obtrusive hum, try disconnecting the earth from the plug at one end of the interconnecting lead. Check out the remaining functions of the amplifier and adjust the six presets RV1 to 6 to suit your equipment if desired.

Carefully fold the wooden cabinet glueing the corners together with a PVA adhesive such as Evostik's "Resin W". Slide the chassis into the wooden sleeve when the glue is properly set, so that the four holes in the bottom line up with the four holes in the base of the chassis. Then bolt on the four rubber feet using the four 4BA ¾in bolts supplied in the kit. If you have bought the parts separately, you will need to cut the excess length off the 4BA 1in bolts. The amplifier is now complete and its reliable, superb quality should give many years of listening pleasure.

Continued on page 55.

NEW BOOKS


The SINCLAIR ZX81
PEEK POKE BYTE & RAM!
Ian Stewart & Robin Jones
THE GIANT BOOK OF COMPUTER SOFTWARE
The BASIC Conversions Handbook for Apple, TRS-80 and PET Users
6502 ASSEMBLY LANGUAGE SUBROUTINES
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Data Converters
How to Identify Unmarked IC's
IC Projects for Beginners

The Sinclair ZX81 (Programming For Real Applications)
by Randle Hurley

The ZX81 with its 16K RAM pack is quite a powerful computer. The aim of this book is to provide "serious" applications without using machine code. All the programming is easy to follow and fully explained. Discard the belief that the ZX81 is too small for real computing work — the flexible techniques described here are just the beginning.
1981. 176 pages. 228 x 152mm.
Order As WG99H (Book MM973)
Price £7.45*NV*

Peek, Poke, Byte & Ram!
by Ian Stewart and Robin Jones

A light-hearted yet serious-minded introduction to the basics of programming in BASIC for the owner of the Sinclair ZX81. Topics covered include setting up the hardward, graphics, looping and branching, logic, character manipulation, subroutines and getting the bugs out. In addition, there are over 50 programs to use with your 1K memory.
1982. 120 pages. 234 x 156mm.
Illustrated.
Order As WA03D (Peek Poke Byte & Ram) **Price £6.25***NV*

The Softside Sampler
Edited by Joan Witham

Description and BASIC listing for TRS80 of 29 complex game programs. Titles include 'Around The Horn', 'Battle Royal', 'Drag Race', 'Goblins', 'Jigsaw', 'Magical Journey', 'Moving Maze', 'Sonic Torpedoes', 'Tenpin Bowling' and many more.
1982. 128 pages. 246 x 176mm.
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Order As WA01B (Book HD496)
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The Giant Book Of Computer Software
by 73 Magazine

Here are hundreds of programs designed to help electronics hobbyists and radio amateurs. There are programs to help you design all kinds of filters. There's a reactance calculator, SWR calculator, antenna design aid, ground station antenna bearing calculator, SSTV pattern generator, RTTY filter design program, picture titling, computerised antenna rotator and much, much more. American book.
1981. 504 pages. 208 x 130mm.
Illustrated.
Order As WG90X (Book FT1369)
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The BASIC Conversions Handbook
by 'Brain Bank'

The book shows how to convert BASIC in Applesoft, PET or TRS80, into either of the other two, as well as variations for TRS80 model III and Apple Integer Basic. Variations in graphics capabilities, are also described as well as PEEK, POKE and CALL statements, cursor and control characters, memory locations and much more. American book.
1981. 88 pages. 228 x 146mm.
Order As WG98G (Book HD534)
Price £6.95*NV*

6502 Assembly Language Subroutines
by Lance A. Leventhal & Winthrop Saville

This book will help you learn 6502 assembly language quickly. It provides code for more than 40 common subroutines, including code conversion, string processing, array manipulation, bit manipulation, I/O and interrupts. The book tells you how to add instructions and addressing modes. You can use the routines shown to speed up a BASIC program and much more. American book.
1982. 560 pages. 234 x 186mm.
Illustrated.
Order As WA05F (6502 Assembly Subs) **Price £12.45***NV*

The 6809 Companion
by M. James

Written for the average assembly language programmer, this is not a beginner's book. The TRS80 colour computer uses the 6809 and it is becoming a very popular microprocessor since it was designed specifically with ease of programming in mind. The book covers all aspects: registers, addressing modes, instruction set, interrupt handling, programming style and converting 6800 programs.
1982. 96 pages. 180 x 108mm.
Order As WG88V (Book BP102)
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68000 Assembly Language Programming
by Gerry Kane, Doug Hawkins and Lance Leventhal

This book provides the information you need to tap the full potential of the most powerful microprocessor yet: the 68000 with its highly-evolved architecture and impressive resources. Each of the 68000's instructions is fully explained and there is a wealth of practical programming examples. Assembler conventions, I/O device programming and interfacing methods are also included. American book.
1981. 624 pages. 234 x 164mm.
Illustrated.
Order As WA04E (6800 Assembly Prog) **Price £14.95***NV*

Computers For People
by Jerry Willis and Merl Miller

If you're thinking of buying a computer for home use then this is the book to read first. All the points you need to consider in your choice are carefully explained. There is also a comprehensive comparison chart between Atari, Apple, TRS80, PET, VIC20 and Texas 99/4A. American book.
1982. 208 pages. 212 x 136mm.
Illustrated in full colour.
Order As WA00A (Computers For People) **Price £8.25***NV*

Don't (Or How To Care For Your Computer)
by Rodnay Zaks

This book will show you the correct way to handle and care for all the elements of a computer system: the processor, CRT terminal printer, tape unit, floppy disks and hard disks. Software and documentation is also covered. American book.
1981. 240 pages. 228 x 152mm.
Illustrated.
Order As WG96E (Book C400)
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How To Design and Build Your Own Custom Robot
by David L. Heiserman

All the procedures for planning, putting together and programming a custom-designed artificial intelligence machine are here in this detail-packed guide. Electrical and mechanical subsystems including driving and steering mechanisms are fully covered. There are lots of electronic circuits and working plans for three microprocessor systems are given along with flowcharts and listings for 8080A, 8085 and Z80 mnemonics. American book.
1981. 462 pages. 208 x 130mm.
Illustrated.
Order As WG92A (Book FT1341)
Price £9.75*NV*

Data Converters
by G. B. Clayton

The book enables the reader to gain a thorough understanding of digital to analogue and analogue to digital converters. Principles of operation are explained in detail and considerations involved in connecting these devices to microprocessors are examined. Procedures for implementing practical applications are shown and the book shows how to interpret data sheet specifications. An excellent text on this important new area in electronics.
1982. 256 pages. 234 x 156mm.
Illustrated.
Order As WA02C (Book MM495)
Price £9.75*NV*

How To Identify Unmarked IC's
by K. H. Recorr

The chart shows how to plot the "Signature" of an unmarked IC. This should then enable the IC to be identified with reference to manufacturers' or other data or to be used in a specific application, without actually assigning a type number.
1982. Fold-out sheet 640 x 450mm.
Cover size 176 x 120mm.
Order As WG87U (Book BP101)
Price 65p*NV*

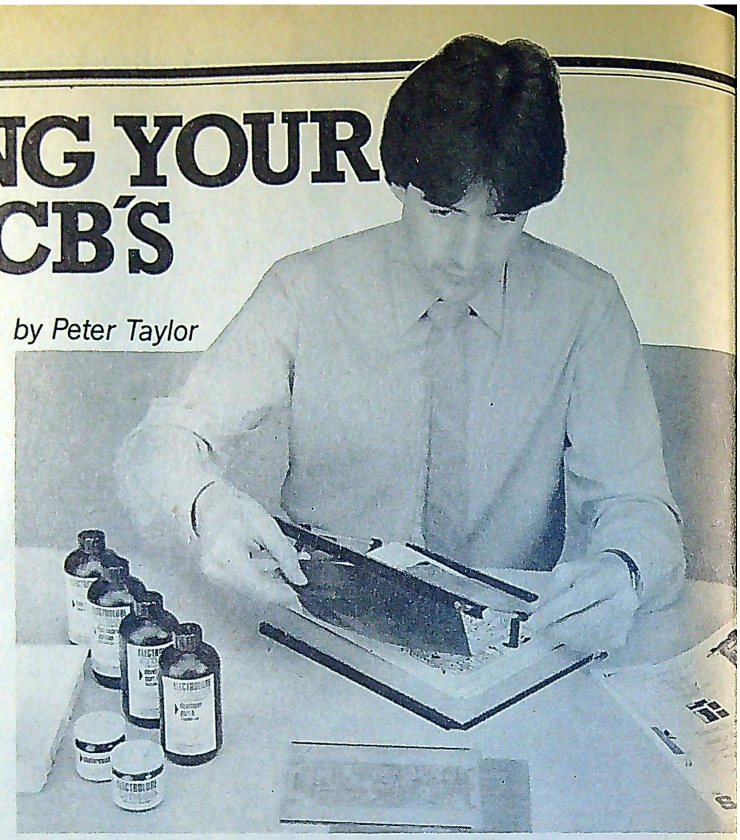
IC Projects For Beginners
by F. G. Rayer

A series of projects for the less experienced hobbyist. All use IC's and projects include power supplies, radio and audio projects including a solar radio. Other projects include an audio generator, interval timer, light relay, sensitive enlarging meter and many more.
1982. 112 pages. 176 x 110mm.
Illustrated.
Order As WA30H (Book BP97)
Price £1.95

Continued on page 60.

MAKING YOUR OWN PCB'S

by Peter Taylor



Printed circuit board construction is becoming increasingly necessary for many electronics projects, owing to circuit complexity and layout considerations. Whilst most magazines publish a printed circuit layout for some of their construction projects, this is of limited use to most constructors as they have no means of copying it. Of course, it is possible to trace the layout, but this is both untidy and time consuming, quite apart from being difficult and prone to errors. This article describes various ways in which the constructor, who has no previous photographic skill, can reproduce these layouts, and then make his own printed circuit boards (pcb's).

Large Scale PCB Production

Pcb's are produced professionally by making the artwork 2 x or 4 x size, and then reducing this to same size, in a large process camera. This increases the accuracy of the final copy by reducing any errors in the layout by a factor equal to the camera reduction. The resulting photographic negative (or positive) is used as a 'phototool' to produce a facsimile image of the layout on a copper-clad printed circuit board that has been coated with a light sensitive resist. When the board is etched, copper is removed from all those parts not protected by resist. This leaves a reproduction in copper of the circuit layout. Most published layouts are same size positives (i.e. the copper tracks are printed in black). These are quite easy to copy photographically without the use of a camera, or other expensive equipment. The principal used is that of reflex copying, and is illustrated in Figure 1.

Light passes through the photographic film or paper; it is reflected by the white areas and absorbed by the black areas. The photographic material therefore receives more exposure from the white parts of the copy than from the black. Processing the photographic material results in a same size copy of the artwork.

Two types of suitable photographic material are available; one is negative emulsion on paper and the other is a positive emulsion on film. The negative emulsion reproduces the artwork as printed, but laterally reversed. As all the photoresists available to the amateur at the moment are positive working (i.e. require a film positive of the artwork) it is much more economical in both time and materials to use the direct positive method.

The CM100 — Circuit Maker

In order to produce a high quality printed circuit board, the film positive must have dense black lines and a clear background. This quality is achieved using a high contrast film processed in a special developer. Unfortunately until now, these products have only been available to the professional large scale user. However, Electrolube Limited are now introducing a printed circuit kit (CM100 — Circuit Maker) which makes them available in quantities suited to the needs of the small scale user.

The film used in this kit has the advantage that no darkroom is needed; it can be handled quite safely in normal room lighting.

The steps necessary to make a film copy from a published artwork are simple. First of all a piece of film is cut slightly larger than the circuit being copied. This is then laid over the circuit layout with the emulsion of the film (i.e. the blue/grey side) in contact with the drawing. The two are sandwiched between a piece of clear glass, and a backing plate covered by foam rubber. The whole of this is then put under pressure, so that the film and the printing are held in even, close contact. Electrolube supply, with the CM100 — Circuit Maker, a frame that has been specially designed for this purpose.

The frame is placed two feet away from a high intensity photoflood lamp, and a series of stepped exposures is achieved by progressively covering the film with a piece of card. These exposures should range between 2 and 5 mins. in 20 second intervals. The film is developed for 2½ mins. in special developer at 20°C, and then placed in a bath of photographic fixer for a minute or two. The processed film will show a series of steps going from very dark to quite light. It is helpful to remember when assessing the step wedge that the longer exposures produce the least density. One of these steps will have a nearly clear background with dense, sharp black lines. The exposure given to this step should be noted, and used to produce a complete copy of the original.

When the final copy has been made, you may find that the background is not completely clear; it may be slightly darker at the corners (due to 'fall-of' of light used to expose the film). This background may be cleaned by taking the film straight from the fixer bath and wiping over the emulsion side with a swab of cotton wool dipped in Electrolube film clearing solution. The film is then refixed for a minute and washed in running water before being hung up to dry.

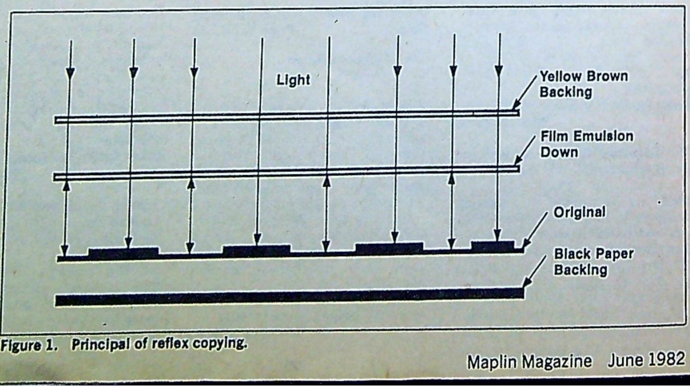


Figure 1. Principal of reflex copying.

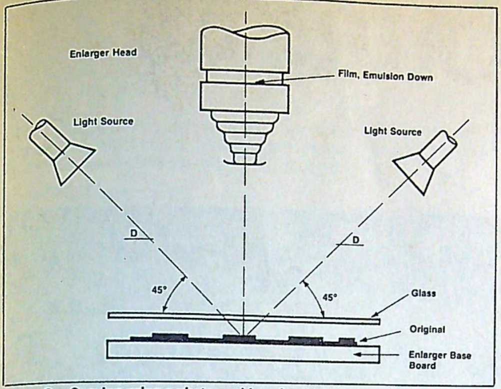
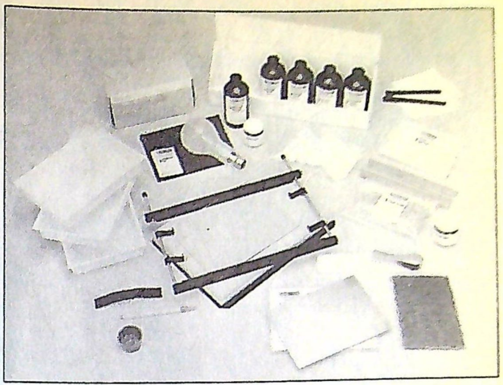


Figure 2. Copying using a photographic enlarger.



The comprehensive Electrolube CM100 kit.

Alternative Method Using a Photographic Enlarger

Another method that can be used by constructors who have a photographic enlarger and a darkroom is to use the enlarger 'in reverse' as a camera. The enlarger will have been set up so that the lens and negative holder are parallel to the baseboard and is therefore ideal for producing accurate copies of the circuit layouts.

For this method, the circuit to be copied is placed under glass in the centre of the baseboard. A negative is then placed in the negative carrier, and the enlarger adjusted so that the image of this negative covers the artwork being copied and is sharply in focus on the page. The controls on the enlarger should then be locked in position, and the enlarger light turned off.

The artwork is illuminated by two lamps equally spaced from the centre of the copy and at 45° to it, as shown in Figure 2. The negative that was used for focussing should now be replaced by a piece of negative working photographic line or lith film, with its emulsion towards the enlarger lens, and a black cloth draped over the enlarger. The film is exposed by switching the two lamps that illuminate the baseboard. Correct exposure time is found by trial and error initially. Providing the lamps are always kept at the same distance, and the lens aperture is not changed, this time should remain the same for future use.

The negative will normally be smaller in size than the original. It is therefore necessary to enlarge this to the right scale by using the enlarger in the conventional mode. The same type of film that was used for the negative is suitable for making this final film positive.

Normally layouts are published as seen from the copper side. In order to make the film positive the right way round, the negative should be placed in the enlarger with its emulsion side towards the light (i.e. the opposite way round to normal).

Producing The Printed Circuit Board

First we will briefly consider some ways of producing pcb's without the use of photography.

The most well known of these involves tracing the track pattern directly on to the copper laminate using carbon paper, and then filling in the areas that are to remain as copper with an etch resist pen, or painting with an etch-resistant material such as nail varnish. Although these both work well as etch resists, it is extremely difficult to produce clean accurate shapes (such as integrated circuit pads), or the fine, closely-spaced lines that are necessary in many circuits. Moreover, the pattern has to be redrawn for each board that is made; consequently modifications, etc become extremely tedious.

Some of the disadvantages discussed above can be overcome by using certain dry transfer symbols, but, of course, it is still necessary to redraw the artwork for each board or modification that is made.

Whichever of the above techniques is used, it is practically impossible to make a double-sided board, and very difficult to achieve any degree of accuracy.

Photographic methods overcome these problems easily and efficiently, as described below.

To begin with the copper laminate is coated with a light sensitive photoresist; this is then exposed through the photographic film copy ('phototool') to ultra violet (i.e. a UV lamp or daylight). Areas that are exposed sufficiently are removed during subsequent development of the resist, leaving an image of the circuit layout which can then be etched.

The copper laminate is first cleaned by rubbing with a fine abrasive pad (as used for washing up). It is best to wet the surface of the board thoroughly with warm water to which a little washing up liquid has been added. When the copper surface appears shiny, the board should be rinsed in running water. If the cleaning has been successful, the water will form an even film over the board surface. If it forms dry patches, cleaning should be repeated.

Wipe away surface moisture with a lint-free cloth and leave the board to dry. Now apply photoresist by aerosol, or by wiping on with a special applicator (as in the Electrolube CM100 — Circuit Maker). The board should be kept horizontal until the resist has dried, otherwise run marks will occur. After coating, put in a dark cupboard until dry. The board should be ready for exposure to the film master in about 45-60 mins. This is carried out in the same frame used to produce the film master. The film is laid on to the photoresist-covered board, and the two are clamped together. Exposure can be to daylight or to a UV lamp. Using the resist supplied with the Electrolube CM100 — Circuit Maker, exposures in the region of 10-30 mins. to daylight can be expected, depending on the strength of the light.

After exposure, the resist is developed in a weak solution of caustic soda. All the parts exposed through the clear areas of the film are removed, leaving a positive copy of the circuit in resist.

After a brief rinse the board can be etched straight away. Various substances can be used, the most common being ferric chloride. This is normally made into a solution containing 1lb of ferric chloride in 2 pints of water. Great care should be exercised when dissolving the ferric chloride — a lot of heat is generated and the reaction is quite violent. **On no account should water be added to ferric chloride — ALWAYS add the ferric chloride to the water.** If any solution should be splashed accidentally into the eyes or mouth, wash with plenty of water, and then seek medical attention.

The Electrolube CM100 — Circuit Maker makes use of a much safer process which is a buffered etchant supplied in a heavy duty polythene container. In this case water is added to the crystals in the bag and, when they are dissolved, etching can begin. The copper board is dropped into the bag, and the bag sealed with a special clip. It is then laid flat on the bench, and pressure is gently exerted with the palms of the hands alternately at each end. This agitates the solution sufficiently; the board should be etched completely in 10-15 mins.

The board is now rinsed thoroughly in running water. The residual photo-resist is stripped by immersing the board in about 2% caustic soda. After a further wash, surplus surface moisture is wiped away, and the board put to dry.

It is necessary tc protect the copper surface from tarnishing by applying a flux lacquer to the copper side of the board. This allows the board to be stored; it also gives excellent solderability. The flux lacquer in the Electrolube CM100 — Circuit Maker is applied in a similar way to the photoresist.

Making professional-quality printed circuits at home is easy, providing it is tackled in a methodical way, and attention is paid to cleanliness throughout. The Electrolube CM100 — Circuit Maker, which is on special offer in this issue, facilitates this; it supplies everything necessary for the small scale user to make his own single or double-sided boards from his own or published artwork. Great care has been taken to make the kit complete. A feature that will prove invaluable to many constructors is that the specially designed frame can be used as an exposure frame for the photographic parts of the process, as well as a component assembly frame. The foam backing is of a special heat-resistant type which allows it to be used to clamp the components; this prevents the components dropping out of the board when it is turned over for lead cropping and soldering. ■

BASICALLY BASIC

Graham Hall, B.Sc.

BASIC Strings

A BASIC string is a sequence of one or more letters or symbols in any combination, enclosed within quotation marks. It is treated as a single collection of alphanumeric data which can be manipulated by means of string functions and assigned to string variables. The use of string variables, string assignment and string arrays has been described in previous parts of 'BASICALLY BASIC'. To understand how the computer represents alphanumeric data and can perform operations with strings, we need to look at the ASCII code (American Standard Code for Information Interchange).

ASCII Code

The ASCII code is a standard developed by the computer industry in which each symbol used in BASIC is assigned a unique binary digit pattern (bit pattern). When a symbol is typed on the keyboard, the terminal converts it to its binary code. For example, if you type the letter A on the keyboard, the terminal converts it to 01000001, which the computer recognises as A. Table 1 lists the set of ASCII character codes. The binary numbers have been converted to decimal numbers to make the assignments easier to understand.

The ASCII code is used to determine alphabetic precedence when alphanumeric data is compared with relational operators. This is described in the next section.

String Operators

A relational operator is a symbol used to compare the value of one variable or expression to another variable or expression within a BASIC program. The use of relational operators to determine numeric relationships has been described previously. Relational operators can also be used to compare alphanumeric data. The comparison is made in terms of the ASCII value of characters to establish alphabetical sequence. Consider the following program:

```
10 LET A$ = "BAS"
20 LET B$ = "SIC"
30 IF A$ < B$ THEN PRINT A$:GOTO 50
40 PRINT B$
50 END
```

Line 10 assigns the string BAS to the string variable called A$.
Line 20 assigns the string SIC to the string variable called B$.
Line 30 is a relational string expression. It compares string A$ with B$ to determine if A$ occurs first in alphabetic sequence. The comparison is made character by character using the ASCII character code. In this case the first letter of the string A$ is 'B' which precedes 'S', the first letter of the string B$, in the ASCII table. Therefore string A$ precedes B$ in alphabetic sequence so the condition is true and the string A$ is printed on the terminal. If the first two characters are the same the comparison proceeds to the second two characters, until a difference is found. For example, if A$ was assigned to the string BAY and B$ was assigned to the string BAT, the first character in each string match. The next two characters also match. Finally the last character of the string A$ is compared with the last character of the string B$. The ASCII code of Y (89) is greater than the ASCII code of T (84), hence the result of the comparison is false and line 40 prints the string B$ on the terminal.

Table 2 lists the string relational operators available in BASIC and their meaning.

Note: it is not permissible to compare a numeric or integer expression to a string expression using a relational operator. If this is attempted an error message will be output by the computer.

String Functions

BASIC provides a set of string functions (similar to the math and print functions described last month) to enable certain operations to be performed on strings. The following descriptions are intended to be general since the functions may perform differently for different computer systems. You should refer to your systems Language Reference Manual for a complete list of functions available in your version of BASIC. The string function names ending with a dollar sign ($) return a string value whereas function names not ending with a dollar sign return a numeric value.

ASCII Function

The ASCII function returns a numeric value that is the equivalent ASCII code for the first character in the string given as the argument to the function. The general format of the ASCII function is: ASC (string), where string is either a string constant or a string variable. For example, the command PRINT ASC ("P") will output 80, the decimal ASCII value of the character P, on the terminal. The following program uses the ASC function with a string variable as an argument:

```
10 A$ = "BASICALLY"
20 PRINT ASC (A$)
30 END
```

When the program is run the ASCII function returns the decimal ASCII value of the first character in the string assigned to the string variable A$, hence the decimal 66 will be output to the terminal.

CHR$ Function

The CHR$ (Character) function is the inverse of the ASCII function. It returns a single character string having an ASCII value of the numeric value specified as the argument to the function. The range of the ASCII codes is 0 to 127. If the value specified to the CHR$ function is outside this range it is treated as modulo 127. This means that 128 is treated as 0, 129 as 1 and so on. A non-integer argument to the CHR$ function will be truncated and the character returned will be that represented by the truncated number.

The following program demonstrates the use of the CHR$ function with different arguments.

```
10 PRINT CHR$ (70)
20 PRINT CHR$ (198)
30 PRINT CHR$ (10)
40 PRINT CHR$ (60.1)
50 END
RUN
F
F

<
```

The output from the program is as shown.
Line 10 prints the character represented by the ASCII code 70 (an upper-case F).
Line 20 specifies an argument of 198. This is treated as modulo 127 (198 - 128 = 70) which is the ASCII code for an upper-case F.
Line 30 outputs a line feed character on the terminal causing a blank line of output. The decimal number specified as an argument to the CHR$ function on line 40 is truncated to an integer. The truncated number (60) represents the character <. (Characters may be different with your micro.)

The remaining BASIC string functions will be described in the next 'BASICALLY BASIC'. ■

Operator	Example	Meaning
=	X$=Y$	Strings X$ and Y$ are equivalent in characters after removing trailing blanks and nulls.
<	X$<Y$	String X$ occurs before string Y$ in alphabetical sequence.
<=or=<	X$<=Y$	String X$ is equivalent to or occurs before Y$ in alphabetical sequence.
>	X$>Y$	String X$ occurs after string Y$ in alphabetical sequence.
>=or=>	X$>=Y$	String X$ is equivalent to or occurs after Y$ in alphabetical sequence.
<>	X$<>Y$	String X$ is not equal to string Y$
==	X$==Y$	Strings X$ and Y$ are identical in characters and length.

Table 2. String relational operators.

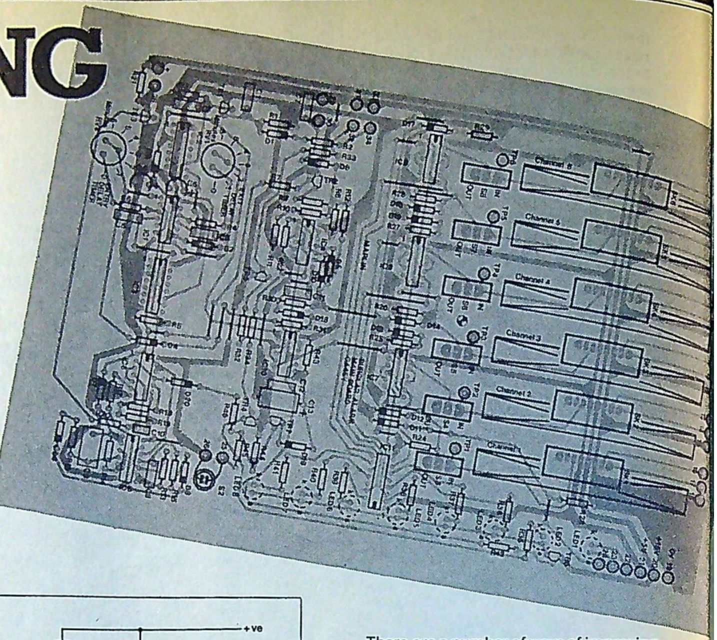
▼ **Table 1. ASCII character code.**

Decimal	Character	Meaning
000	NUL	Null
001	SO11	Start of heading
002	STX	Start of text
003	ETX	End of text
004	EOT	End of transmission
005	ENQ	Enquiry
006	ACK	Acknowledge
007	BEL	Bell
008	BS	Backspace
009	HT	Horizontal tab
010	LF	Line feed
011	VT	Vertical tab
012	FF	Form feed
013	CR	Carriage return
014	SO	Shift out
015	SI	Shift in
016	DLE	Data link escape
017	DC1	Device control 1
018	DC2	Device control 2
019	DC3	Device control 3
020	DC4	Device control 4
021	NAK	Negative acknowledge
022	SYN	Synchronous idle
023	ETB	End of transmission block
024	CAN	Cancel
025	EM	End of medium
026	SUB	Substitute
027	ESC	Escape
028	FS	File separator
029	GS	Group separator
030	RS	Record separator
031	US	Unit separator
032	SP	Space or blank
033	!	Exclamation mark
034	"	
035	#	Number, sign
036	$	
037	%	
038	&	
039	'	
040	(	
041	)	
042	*	
043	+	
044	'	
045	—	
046	.	
047	/	
048	0	
049	1	
050	2	
051	3	
052	4	
053	5	
054	6	
055	7	
056	8	
057	9	
058	:	
059	;	
060	<	
061	=	
062	>	
063	?	
064	@	
065	A	
066	B	
067	C	
068	D	
069	E	
070	F	
071	G	
072	H	
073	I	
074	J	
075	K	
076	L	
077	M	
078	N	
079	O	
080	P	
081	Q	
082	R	
083	S	
084	T	
085	U	
086	V	
087	W	
088	X	
089	Y	
090	Z	
091	[	
092	\	
093	]	
094	↑	
095	←	
096	`	
097	a	
098	b	
099	c	
100	d	
101	e	
102	f	
103	g	
104	h	
105	i	
106	j	
107	k	
108	l	
109	m	
110	n	
111	o	
112	p	
113	q	
114	r	
115	s	
116	t	
117	u	
118	v	
119	w	
120	x	
121	y	
122	z	
123	[illegible]	
124	|	
125	[illegible]	
126	~	
127	DEL	

STARTING POINT

by Robert Penfold

Introducing the fundamentals of electronics for the constructor.



Classes of Amplification

The amplifiers considered so far in "Starting Point" have all been of the type where a transistor has been used in one of the three amplifying modes with a resistor as the collector or emitter load, as appropriate. A simple arrangement of this type is perfectly suitable for use in low level stages where powers of no more than a few milliwatts or so are involved, but the inefficiency of this class of amplifier is a severe drawback when an output power of a few hundred milliwatts or more is required.

For example, if we consider the simple output stage shown in Figure 1, this is a straightforward common emitter stage having R1 to provide base biasing, R2 as the collector load resistor, and input and output DC blocking provided by C1 and C2 respectively.

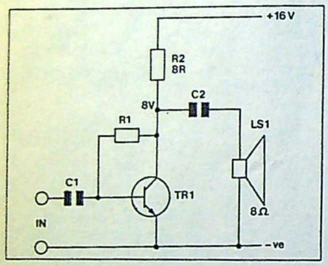


Figure 1. Simple Class A output stage.

As usual, the circuit is biased so that Tr1 has a collector potential of half the supply voltage, and with 8 volts across 8 ohm load resistor R2 there is obviously a current flow of 1 amp through R2 and Tr1. This gives an input power of 16 watts, with R1 and Tr1 each dissipating 8 watts.

The maximum output voltage from this stage is about 16 volts peak to peak, and will be a little less than this in practice since even with Tr1 switched fully on there is still likely to be a potential of about 1 volt at its collector. No practical transistor can produce a collector potential much below this figure when operating at a high collector current. We are also assuming that the circuit is driving an infinite load impedance, whereas it is in fact driving a load impedance of just 8 ohms. The load impedance is, in fact, equal to the 8 ohm output impedance of the amplifier, and this causes the output voltage to be loaded to just half the unloaded figure. In other words the maximum theoretical output voltage swing is only 8 volts peak to peak under load, and in practice would not even be as high as this. In terms of RMS output voltage this is only about 2.83 volts.

The output power of an amplifier is E^2/R where E is the RMS output voltage and R is the load impedance. In this example E^2 is equal to 8, and dividing this by the 8 ohm load impedance obviously gives an output power of 1 watt RMS. In other words an input power of 16 watts is required to give a maximum output of only 1 watt RMS!

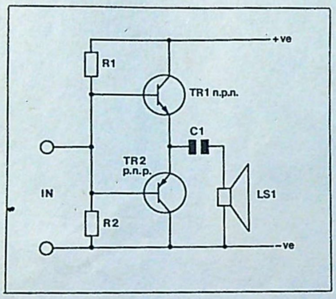


Figure 2a. Basic Class B (AC coupled) output stage.

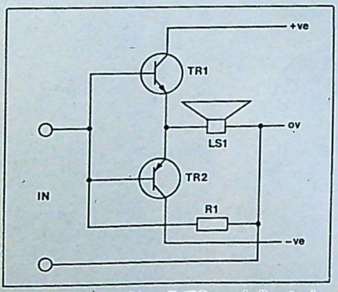


Figure 2b. Basic Class B (DC coupled) output stage.

Higher output power can be obtained by reducing the value of R2 so that the output impedance of the amplifier is reduced, and the loaded output voltage is increased. However, this would cause the input current and power to rise, and would actually decrease efficiency. Increasing the value of R2 would reduce the input current and power, but would also give a lower loaded output voltage and maximum output power, and would again actually produce a reduction in efficiency.

There are a number of ways of improving the efficiency of simple amplifiers of this general type, which are known as 'Class A' amplifiers, but the efficiency of a true Class A stage is always rather low. The disadvantages of this low efficiency are the need for a substantial and expensive power supply to give even quite modest output powers, the need to use high power components in the output stage, and the generation of a substantial amount of heat. Battery operation also tends to be a little impractical using primary cells since the high current consumption results in expensive batteries becoming exhausted at an alarming rate.

Class B Operation

Virtually all audio power amplifiers use some form of Class B operation, and Figure 2 (a) shows the basic Class B output stage on which most modern designs are based. Figure 2 (b) shows the DC coupled output version, and operation of the two circuits is essentially the same. However, the DC coupled version is a little easier to understand and we will therefore consider the operation of this circuit.

The circuit has dual balanced supplies, and the loudspeaker connects between the output of the amplifier and the 0V rail. Tr1 and Tr2 are both emitter followers and therefore each provide approximately unity gain. R1 biases the input and output of the amplifier to the 0V rail potential, and under quiescent conditions there is thus no voltage present across LS1.

If a positive input signal is applied to the circuit Tr1's emitter goes positive and Tr1 supplies power to LS1. The output impedance of the circuit is very low and despite the low load impedance Tr1 can supply virtually the full positive supply potential to LS1. Tr2 is cut off and plays no active role with a positive input signal.

With a negative input signal Tr1 is cut off and it is Tr2 that supplies power to LS1. Once again the output impedance is very low, and almost the full negative supply voltage can be delivered to LS1.

This system gives much better efficiency than a Class A circuit since the maximum peak to peak output voltage is virtually equal to the sum of the two supply voltages, and the supply current is equal to the output current. Thus the average supply current varies in sympathy with the output, and is zero under quiescent conditions. This avoids high current consumption and heat generation under stand-by or low volume conditions, and when the amplifier is fully driven it is possible to obtain an efficiency of over 70%. This contrasts with the high continuous current consumption and low efficiency of a Class A circuit.

Quiescent Bias

In practice the circuits of Figure 2 would give very poor results due to what is termed "crossover distortion". This comes about due to the base-emitter potential of about 0.6 volts that is needed before a silicon transistor begins to conduct. This makes it necessary to have an input signal of at least +0.6 volts before there is any output signal at all! Even with an output signal from the circuit there is severe distortion as the low voltage part of the waveform is absent. A triangular input waveform as shown in Figure 3(a) would emerge from the circuit as shown in Figure 3(b).

Crossover distortion is normally overcome by incorporating some additional components at the input of the output stage, as shown in the circuit of Figure 4. Here the driver and output stages are effectively merged together, and practical designs are invariably of this type. Tr1 is the driver stage and Tr2 plus Tr3 are the complementary emitter follower output stage. The amplifier is biased by R1 and R2, and the purpose of D1, D2 and RV1 is to give a quiescent bias voltage across the bases of Tr2 and Tr3.

RV1 is adjusted so that the bias fed to Tr2 and Tr3 is just sufficient to bring them to the threshold of conduction so that Tr2 is switched on if the drive voltage even marginally positive, and Tr3 is switched on as soon as the drive voltage from Tr1 starts to go negative. In practice it is usually necessary to use a slightly higher bias than this so that under quiescent conditions there is a small but significant current flowing through Tr2 and Tr3. This is necessary due to the comparatively low gain of practical transistors when they are only marginally above the threshold of conduction, and the relatively small but nevertheless significant amount of crossover distortion that this would produce. By biasing the output devices beyond this low gain part of their transfer characteristics this crossover distortion is avoided.

It may, in fact, be necessary to use quite a large quiescent bias current through the output transistors in order to produce really low crossover distortion. Circuits of this type are generally called Class AB amplifiers, and this is simply because at low and medium output powers one transistor acts as the amplifying device and the other output transistor acts as its emitter load. This is, in fact, a form of Class A operation, and it is only at high powers that one transistor is cut off while the other drives the load, and true Class B operation is obtained. It is from this mixture of Class A and Class B operation that the term Class AB is derived.

Most practical designs use only a low quiescent bias current through the output transistors, and this is quite understandable since Class AB working obviously partially loses the advantages of Class B operation. Also, although Class AB amplifiers avoid crossover distortion this advantage is offset by an increase in other types of distortion.

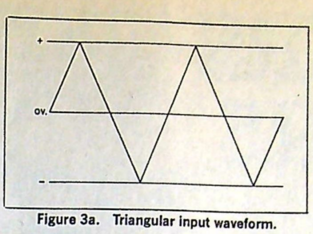


Figure 3a. Triangular input waveform.

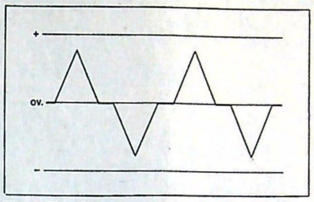


Figure 3b. Output waveform, showing crossover distortion.

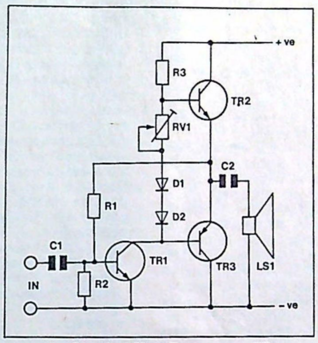


Figure 4. Practical Class B power amplifier configuration.

Practical audio power amplifiers almost invariably use a low quiescent bias plus a generous amount of negative feedback to reduce crossover distortion and other types of distortion.

Thermal Runaway

The bias voltage supplied across the bases of Tr2 and Tr3 is extremely critical, with a marginally low potential giving severe crossover distortion and a slightly high bias producing a very large quiescent current through the output transistors. The position is made worse by the heating that occurs in Tr2 and Tr3 when the amplifier has been in use for a short while. Bearing in mind that Tr2 and Tr3 will inevitably have to handle substantial power levels a significant amount of heat generation in these transistors is inevitable.

As Tr2 and Tr3 heat up, their base-emitter threshold voltage decreases, and the quiescent bias current increases. The increasing bias current produces further heating in the output devices which, in turn, gives an increase in the bias current, and this regenerative action continues until the output devices overheat and are destroyed unless suitable preventative measures are taken. This thermal feedback is called "thermal runaway".

D1 and D2 are used to prevent thermal runaway, and they achieve this by sensing the rise in temperature of the output transistors. They may actually be mounted on the same heatsink as the output transistors in order to ensure that they rapidly and properly sense the temperature changes. The voltage developed across D1 and D2 varies with temperature, and decreases as temperature is increased. This gives a strong stabilising effect on the quiescent bias current with the bias voltage automatically decreasing as the output transistors heat up.

There are other ways of providing thermal stabilisation, such as using a transistor in the amplified diode configuration, or a negative temperature coefficient thermistor. Whatever method is used the circuit must be carefully designed as there is otherwise a likelihood of over-compensation and consequent crossover distortion when the output transistors heat up, or insufficient thermal stabilisation which would simply result in slower thermal runaway!

Most low and medium power audio amplifiers these days are based on an integrated circuit, and thermal stabilisation is not a problem here since the output transistors and the temperature sensing components are on the same chip. This enables very predictable results and very accurate stabilisation to be easily obtained.

Power MOSFETs are becoming increasingly popular for use in the output stages of high power audio amplifiers, and amongst other advantages they require no thermal stabilisation. These devices have a positive temperature coefficient, like bipolar transistors, at low operating currents. However, this changes to a negative temperature coefficient at currents of more than about 80mA. In other words, with a bias current of less than about 80mA an increase in temperature produces a small increase in the quiescent bias current, but at more than about 80mA an increase in temperature results in a decrease in bias current. The quiescent bias current therefore tends to be self-stabilising, and thermal runaway cannot occur.

Class C

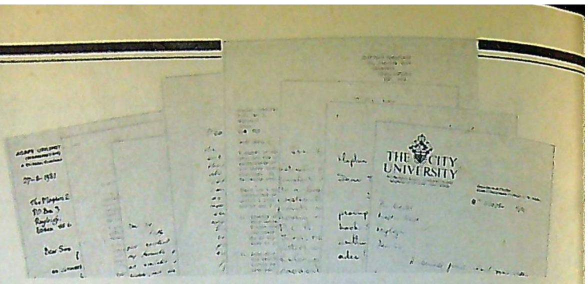
Class C amplifiers are not often encountered, and are only applicable to radio frequency circuits. With this type of amplifier the amplifying device is reverse biased so that it only conducts during quite a small part of each output cycle. The load for the amplying device must be a tuned circuit which "rings" at its resonant frequency and effectively fills-in the missing part of the output waveform. A mechanical analogy of this is the periodic striking of a bell to produce a continuous ringing sound.

The advantage of Class C operation is the very high level of efficiency that can be attained, but a lot of filtering is normally needed at the output to produce a really pure output signal.

There are other modes of operation, and Class D for example is a form of high efficiency audio power amplifier. However, these other modes of amplification tend to be quite complex and are mostly just variations on one of the operating modes already described. Class D for example, uses what is really just a Class B output stage, and it is the preceding and following circuitry that give the higher efficiency.

It is worth noting that although the circuits shown here use only a single device in the output stage, or a single device in each half of the output stage in the Class B designs, practical circuits often employ two devices in the Darlington Pair configuration or some similar arrangement. This is often necessary in order to produce a really low output impedance so that large output currents can be easily provided with only a modest drive current. ■

READERS LETTERS



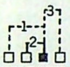
4-Pole Slide Switch

Dear Maplin,
Please forgive me if I appear to be repeating myself, only I've just bought your new magazine 'Electronics' first issue and what a surprisingly good buy it is too!
Problem is, when I turned to page 63 'Amendments to Catalogue' there is no mention of the switch I mentioned a while back, and as my previous letter probably fell on stoney ground I shall briefly recap.

FH38R 4 POLE 3 POSN SLIDE
(PAGE 279)

Having used this switch once again am convinced at this error, rather annoying and repetitive.
Connection positions should be transposed as shown:

TO READ:



A. DONALDSON
Walton-on-Thames, Surrey

We reprinted the manufacturer's data, but unfortunately, not all of it. The missing piece of data shows the position of the knob for each number. We agree that without this vital piece of information, your drawing is more logical.

Removable Price List

Dear Sir,
I have only one criticism — hopefully constructive — to make about an otherwise excellent magazine: please arrange the pages so that the "Price List" can be removed without disrupting the magazine articles. Removing the latest Price List in its entirety takes Readers Letters and the first page of the Home Security System project. In the first issue, New Books and the first page of the Universal Timer project would go. In this particular case, perhaps you could have "surrounded" the Price List with the two pages of Maplin News (pps 63/4 Issue 1), much of which applies to the Catalogue anyway.

P. HUNT
Wimborne, Dorset

Whilst I have some sympathy with your suggestion, I have to balance this with the overall look of the magazine. Breaking up Maplin News and siting it either side of the Price List makes the magazine look scrappy. Also it does not allow us to have a double-page spread to give extra impact to the article following the Price List. I would be interested to hear other people's views, but at the moment I am not sufficiently persuaded to change the layout.

Countdown Timer Circuit Wanted

Dear Sir,
As a regular reader of your magazine(s!) I write to ask if through the readers letters pages of your magazine any reader could help with the source of a published circuit for a countdown timer. There does not seem to be a dedicated chip available for this purpose nor can I find details of a suitable circuit.
There must be many uses for such a device (sports, quiz games etc, etc) — perhaps you could consider developing such a device.

I. E. SHEPHERD
Johnstone, Renfrewshire

Any offers?

Additions To Burglar Alarm

Dear Sir,
I must say that I was impressed with the excellent specification on the Maplin Burglar Alarm in the latest edition of the Maplin Magazine.
However, there are a few 'improvements' which, if they could be incorporated, would make for an even better security device.
1. PANIC SWITCHES with a latching operation that would operate the external alarm whether or not the main control was 'on' or 'off'.
2. AN AUTOMATIC RE-SET for the external alarm, that would shut the alarm off after, say, 20-25 minutes. The re-setting to take account of the 'new' condition, i.e. the 'offending' door or window remaining open etc.
3. RE-CHARGEABLE CELLS for the external alarm box, instead of dry batteries, linked to a remote battery condition monitor (i.e. LED's) that would indicate their state of charge at a glance, so that the cells could be charged before they became exhausted.
I realise that this is a tall order, but if any other reader is able to offer circuit modification to suit, I should like to hear from him/her.

M. MILLS
London SE26

If a panic switch is practicable, then details will be published in issue 4. The same goes for the alarm cut-off timer. The rechargeable cells are not practical, I'm afraid. In any case unless your alarm goes off when the mains is off you will only need to replace the batteries once every two or three years. So for the cost of a set of ni-cads, you will get ten years worth of dry cells. So we didn't think that the complication of charging cells in the external box was really worth the effort.

Ideas For The Mag

Dear Sir,
Here are a few suggestions for your new electronics magazine.
(a) Simple 7 channel Citizens Band radio.
(b) Inexpensive television space game unit featuring Invaders, UFOs, etc.
(c) Mini pocket sized alarm clock.
(d) Auto toaster cooking timer.
(e) Adaption of RK22Y, 23A, and 24B (6, 9 and 12 volt output silicon solar panels) to AC converted stepped up voltages to result in 240 volts so that it could be used on mains equipment.
P.S.: I think your magazine is helpful and very enjoyable to read.

DOMINIC LOUGHLIN
(age 11)
Chorley, Lancs

Your first three ideas would, I agree, be very interesting, but to pay for the development costs, they would also have to be saleable and frankly, there is no way a kit of parts for any of these ideas could be assembled for less than the cost of a ready-made unit in the shops. Consequently, their sales potential would be very small. We do think a kitchen timer, possibly with an add-on mains controller (for toasters or whatever) would be an interesting little project.

Unfortunately your idea for the silicon cells is not practical at all. To gain a voltage increase there must be a similar decrease in current. With the 12V panel we would require a 20-times increase in voltage and there would then be a 20-times decrease in current. Because of the inefficiencies in this kind of circuit in practice, the current would actually be much lower than this. Then we would need to drive an oscillator of some sort to convert to AC. I would think you would be lucky to end up with 1mA at 240V AC. And there's not a lot you could do with that. For example a colour TV draws about 1A from the mains, so you'd need a thousand 12V panels to run one. Clearly, an expensive proposition.

Congratulations

Dear Sir,
Another electronics magazine? NO. Congratulations on entering the field late in the day and beating the opposition hands down!
I have been a satisfied mail order customer for some time and I still marvel at the speed with which you deliver the goods. I recently received my first copy of the Maplin Mag after long deliberation on whether to fork out on yet another electronics mag — your introductory offers tipped the balance — and I am delighted. I enjoy the wide range of projects from the absolute beginner's cinche up to the more demanding Timer project. In addition your range of features has something for everybody. Keep up the good work — I can't wait for the next issue!

J. E. MABBOTT
Rhosneigr, Gwynedd

Thanks Mr Mabbott. Hope you enjoy this issue too.

What About MES56?

Dear Doug,
Thanks for the new magazine — a very useful addition to the Maplin catalogue. Could one suggest for future inclusion an article on the growing Maplin empire, and also adding to that empire with a Leeds or Manchester shop.
Normally I order from you by telephone and every time I get a reply paid envelope and order form which finish up in the rubbish bin. How about asking customers who telephone if they require these and thereby saving on costs. Also I was sorry to see the discount voucher scheme discontinued but can understand that as it operated it could be costly to administer. Could I suggest a) A discount scheme for quantity orders of the same part; b) A discount for large orders say over £30. Maplin are very competitive, compared with trade component suppliers, on a one-off basis but not on large quantities.
One of my main interests in electronics is electronic organs. Some three years ago I started building an MES53 and have enjoyed this project but feel that further developments on this organ have been pushed to one side to develop the Matinee. However, when I heard the MES organ at Breadboard '80 it had certain extra effects so you must have come some way to developing MES56 and 57 mentioned in the last catalogue but not the most recent. When can I look forward to more developments on the MES organ? I look forward to hearing.

I. D. MANZIE
Skipton, N. Yorks

You will be pleased to hear that we are considering opening a Maplin store in Manchester, once our Birmingham shop (opening soon — the announcement will be in the Birmingham "Evening Mail") is open. Frankly, it's cheaper for us to have one pile of packs of order form and envelope and just put one in every order, than to have two piles, one without envelope, and sort the orders; bearing in mind that this part of the packing is done very quickly: on an average day the team of packers completes an order every 20 seconds.

We have on many occasions considered quantity discounts, but it is an added complication to our throughput which is now a very speedy and efficient animal. We may implement a discount scheme one day, but not until we are certain we can cope at our usual speed, with the extra business this would generate.

We are still hoping that we can fit MES56 into our schedule soon. Although most of the design work was completed a long time ago, there is a considerable amount of documentation still to be done. At the present time it seems unlikely that MES57 will be produced.

Ultrasonic Burglar Alarm

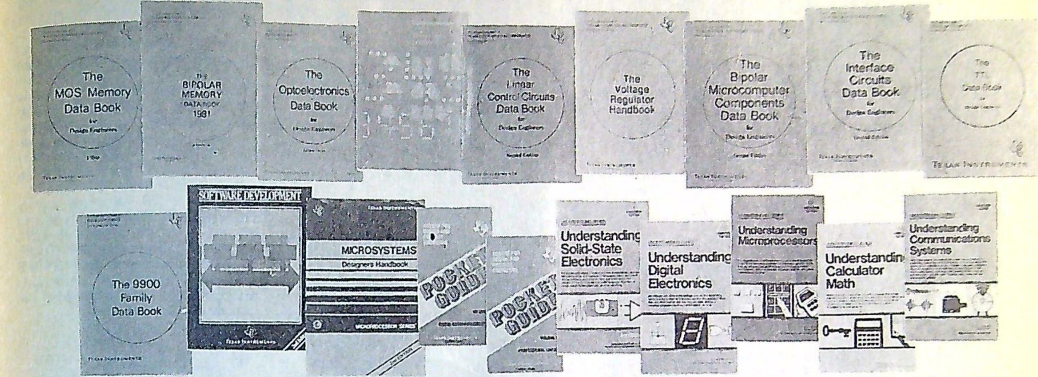
Dear Sir,
I enjoyed the first publication of your electronics magazine.
Could you inform me if you have any articles in future editions relating to the building of Ultrasonic Burglar Alarms, if not could you suggest any alternative reading matter on this subject.

M. J. ILSLEY
Bournemouth

Yes. You'll be pleased to hear that an ultrasonic intruder detector for use on its own or with our Home Security System will be featured in our next issue.

Continued on page 54.

TEXAS INSTRUMENTS DATA LIBRARY


The MOS Memory Data Book
The BIPOLAR MEMORY DATA BOOK 1981
The Optoelectronics Data Book
The Linear Control Circuits Data Book
The Voltage Regulator Handbook
The Bipolar Microcomputer Components Data Book
The Interface Circuits Data Book
The TTL Data Book
TEXAS INSTRUMENTS
The 9900 Family Data Book
SOFTWARE DEVELOPMENT
MICROSYSTEMS Designers Handbook
POCKET GUIDE
POCKET GUIDE
Understanding Solid-State Electronics
Understanding Digital Electronics
Understanding Microprocessors
Understanding Calculator Math
Understanding Communications Systems

The MOS Memory Data Book
Full data sheets for T.I.'s range of dynamic and static RAM's and EPROM's. An interchangeability guide is included.
1980. 190 pages. 234 x 170mm. Illustrated.
Order As WA06G (TI MOS Memory Data) Price £4.95*NV*

The Bipolar Memory Data Book
Full data sheets for TI's range of bipolar PROM's and RAM's, and TI's bipolar FIFO and character generator. A cross-reference guide is included.
1981. 64 pages. 234 x 170mm. Illustrated.
Order As WA07H (TI Bipolar Memo Data) Price £1.45*NV*

The Optoelectronics Data Book
Full data sheets covering TI's complete range of opto products: photodetectors, infrared emitters, optocouplers, sensor/emitter arrays, LED's, displays, amplifiers for photodiodes, optical waveguide transmitter and plastic fibre-optic data links. Data sheets for TI's thermal print heads are also included. An interchangeability guide is included.
1979. 320 pages. 208 x 148mm. Illustrated.
Order As WA08J (TI Opto Data) Price £5.25*NV*

Optoelectronics Theory and Practice
A theoretical and practical introduction to many kinds of optoelectronic products. There is an abundance of practical hints and suggestions as well as the necessary theoretical background to enable users to develop their own circuits and applications.
1976. 456 pages. 208 x 148mm. Illustrated.
Order As WA09K (Opto Theory/Practice) Price £7.50*NV*

The Linear Control Circuits Data Book
Full data sheets covering TI's range of op-amps, comparators, timers, video and log amps, voltage level detectors, A to D converter components, analogue switches and Hall-effect devices. Also covered are TI's zero-crossing detector, doubly-balanced mixer, precision level detector, over-voltage sensing circuits and 3-channel stepper-motor controller. An interchangeability guide is included.
1980. 416 pages. 232 x 178mm. Illustrated.
Order As WA10L (TI Linear Control) Price £5.25*NV*

The Voltage Regulator Handbook
Full data sheets covering TI's complete range of voltage regulators. There is also a large section covering basic power supply design, external pass transistor considerations, input filter designs, voltage rectification techniques, and mounting and heat-sinking techniques.
1977. 208 pages. 232 x 172mm. Illustrated.
Order As WA11M (TI Voltage Regulator) Price £5.65*NV*

The Bipolar Microcomputer Components Data Book
Full data sheets covering TI's range of 4-bit-slice Schottky processors and I²L microcomputer components. Also included are data sheets for TI's fibre-optic data link controllers, bipolar PROM's, RAM's and FIFO, some support functions and an 8-bit by 8-bit parallel byte multiplier.
1979. 368 pages. 232 x 176mm. Illustrated.
Order As WA12N (TI Bipolar Micro) Price £5.75*NV*

The Interface Circuits Data Book
Full data sheets for TI's range of peripheral drivers, line drivers, sense amplifiers, MOS drivers, memory drivers, display drivers and IC sockets. An interchangeability guide is included.
1981. 752 pages. 242 x 172mm. Illustrated.
Order As WA13P (TI Interface Data) Price £8.50*NV*

The TTL Data Book
Full data sheets covering TI's very large range of TTL IC's. An interchangeability guide is included.
1982. 1184 pages. 210 x 148mm. Illustrated.
Order As WA14Q (TI TTL Data) Price £10.00*NV*

The 9900 Family Data Book
Full data sheets covering TI's 9900 series microprocessors, I/O devices and memory support chips. A benchmark report is included.
1981. 776 pages. 208 x 148mm. Illustrated.
Order As WA15R (TI 9900 Data) Price £11.50*NV*

Software Development Handbook
by Geoff Vincent & Jim Gill
The book takes the reader through the elementary ideas behind software development to a description of microprocessor Pascal, Power Basic and 9900 assembly language. The book's aim is to provide a text for the emerging discipline of software engineering for microprocessors incorporating all that will prove to be of lasting value.
1981. 456 pages. 276 x 214mm. Illustrated.
Order As WA16S (TI Software Develop) Price £14.40*NV*

Microsystems Designers Handbook
The book contains shortform data sheets of TI's range of single-chip microcomputers, microprocessors, microcomputer boards, speech synthesisers, development systems and software.
1981. 176 pages. 296 x 208mm. Illustrated.
Order As WA17T (TI Microsystems) Price £4.95*NV*

Digital Integrated Circuit Pocket Guide
A clearly arranged summary of TI's range of TTL IC's with brief data, logic and pin assignments.
1981. 352 pages. 184 x 106mm. Illustrated.
Order As WA18U (TI Digital IC Guide) Price £4.50*NV*

Linear Integrated Circuit Pocket Guide
A clearly arranged summary of TI's range of linear IC's with brief data and pin assignments.
1981. 256 pages. 184 x 106mm. Illustrated.
Order As WA19V (TI Linear IC Guide) Price £4.50*NV*

Understanding Solid-State Electronics
The book is designed for the reader who wants to understand electronics quickly without resorting to mathematics. The book teaches technical concepts in a way that makes it accessible to someone who would have trouble wiring a doorbell. Coverage runs from basic electricity to large scale integrated circuits.
1978. 280 pages. 208 x 132mm. Illustrated.
Order As WA20W (Understanding Electronics) Price £3.35*NV*

Understanding Digital Electronics
by Gene McWhorter
For those who understand the concepts covered in 'Understanding Solid-State Electronics', this book will give you an understanding of the electronic circuitry in many types of digital electronics, from the basic idea of a transistor saying "yes" or "no", to entire digital systems made up of thousands of such circuits.
1978. 264 pages. 208 x 132mm. Illustrated.
Order As WA21X (Understanding Digital Electronics) Price £4.95*NV*

Understanding Microprocessors
by Don L. Cannon and Gerald Luecke
The book teaches how microprocessors work, and what they can do. The book covers fundamentals, system applications, programming concepts, an 8-bit and a 16-bit microprocessor application.
1979. 288 pages. 208 x 132mm. Illustrated.
Order As WA22Y (Understanding Micros) Price £4.95*NV*

Understanding Calculator Math
This book goes far beyond what you can find in your owner's manual. Whether you're good at figures or not, this book contains the basic information, formulae, facts and mathematical tools you need to unlock the real power of your calculator. With scores of keystroke by keystroke examples, the non-technical language will help you find solutions to problems you never imagined possible on your calculator.
1978. 224 pages. 208 x 132mm. Illustrated.
Order As WA23A (Understanding Calc Math) Price £4.95*NV*

Understanding Communications Systems
by Don L. Cannon and Gerald Luecke
An easy to understand look at the world of electronic communications. The book gives an overview of the types of systems, the basic concepts of their operation and how they send and receive information. There is an in-depth look at AM/FM radio, TV, telephones, computers and even satellite systems.
1980. 288 pages. 208 x 132mm. Illustrated.
Order As WA24B (Understanding Comms) Price £4.95*NV*

READERS LETTERS

Continued from page 52

What About An Article On PCB's

Dear Sir,
I have just received the first two issues of your Maplin Mag with which I am greatly pleased. One main advantage to me is that most, if not all, of the components and hardware can be purchased through Maplin, whereas in some of the other electronics magazines you have to search to find catalogues that have maybe one small item that another catalogue has not got in stock.
As I am a bit of a newcomer to electronics I found your 'How To Solder' article in the first issue most useful. I would be pleased to see a similar article on how to make PCB's.

S. BURDEN
Leicester

By an amazing coincidence this month we have an article describing how to make PCB's and a special offer to go with it. How's about that then?

CB Article A Big Help

Dear Sir,
I would like to say that I think your March issue of the magazine was a big improvement over the first issue, much more interesting in every way. One particular item that really made my day was your comment on ground planes for CB. I found how difficult it was to obtain an antenna for loft installation (I don't know why dealers are not stocking this line, because we all do not have gardens to put up a mast). However, I purchased a "Big Chief" TBR140 and put it out of a skylight but could not get the SWR down until I read your article. I purchased 10 metres from you of the 32/.02 wire and threw two and a bit metres out from each corner of the skylight connected to the base of the antenna and I am pleased to say I got the SWR down to 1.2. Thanks a lot. I have since had 'copy' from here to Winter Hill, Liverpool, Southport and, believe it or not, Prestatyn, N. Wales.
One other point I would like to mention is why do you not cater for items or kits printed in E.E. or P.W. magazines. Recently I wished to build a PSU but found I could not get half of the items from you, so I decided on buying the complete kit from another firm offering a speedy service. How sorry I am. It was over three weeks for delivery, not counting telephone calls at standard rate, five items were missing, more phone calls and letters and then when assembling I found a couple of the items were of the incorrect value or type. These I am now ordering from you. I must say that you do give a wonderful service and for this I thank you very much.

T. E. FLINT
Skelmersdale, Lancs

It just isn't practical for us to stock all the parts needed for all the projects in all the magazines. Although we often notice magazines stating that such-and-such a part is only available from a particular supplier when in fact we sell it too; so it's always worth checking.

Interfacing Microprocessors

Dear Sir,
My compliments on a very interesting and well-balanced magazine. There may be nine others on the news stands but so far as I am concerned they will stay there!
My interest is mostly in digital electronics, and I would welcome projects relating to the interfacing of microprocessors to the "outside" world. I am sure that if you published a few well-chosen projects for, say, the ZX81 or the BBC micro (not to mention the Atari!) then sales would benefit and yet more readers would be made happy! Perhaps if you publish this letter this idea will be confirmed?

A. J. BYTHEWAY
Great Missenden, Bucks

Your comments are much appreciated by everyone here at Maplin. We agree that interfacing is a very interesting subject at the moment and we have several articles and projects along these lines lined-up for the future.

Four Questions

Dear Sir,
Would you please print this in the Maplin Mag:
Will Maplin be stocking the BBC Microcomputer System?
Why are there no blue LEDs?
Will Maplin please consider stocking: Casio calculators and watches + batteries, TDK tapes and ready made hi-fi synthesiser equipment for those of us who aren't electronic geniuses?
How about a review of the BBC Microcomputer System in the Maplin Mag?

J. G. ASHDOWN
Grays, Essex

1. We do not have any plans at present to sell the BBC micro. Truthfully, we are only interested in selling genuine home computers, not business machines. The BBC micro does not and will never have the kind of software backup being built up by Atari and Commodore and so in our opinion will never be a genuine home computer.
2. Blue LED's have been available for some years, but they are difficult to make and Siemens for example have been selling them for £80 each. Prices have recently fallen owing to use of a different material and within a few months we expect blue LED's to be available for about £5 each. Even at that price though, it's doubtful that we would consider stocking them.
3. We certainly could stock all the items you mention, but with postage costs we'd almost certainly be dearer than the electrical shop just down the road. The big chain stores buy so many units that their prices are very competitive and I don't think we could compete.
4. We are not planning a review of the BBC micro at the moment.

Maplin Mag Should Be Monthly

Dear Sir,
I would like to endorse C. W. Dudley of Kent, who mentioned it was a pity the Maplin Mag was not a monthly. Surely it would be possible to operate a monthly system, only entering the price list every three months. Also, I feel that the quality of the articles in this periodical are of a much higher standard than those of a large periodical such as Practical Electronics (who's mag I stopped buying in favour of Maplin!).
Unfortunately, I note there is a series called "Basically BASIC", I have both the December and March issues, but did this series begin before, and if so, how could I obtain "back numbers" of the series only.
Carry on the good work, Maplin.

I. GREGORY
Hadfield, Cheshire

A magazine without advertising gets most of its revenue from subscriptions. Each issue costs a lot of money to produce and there's no way we could reduce the price from 60p a copy. There is no doubt that our level of subscriptions is as incredibly high as it is due to the fact that it costs only £2.40 a year. If we went monthly this would rise to £7.20 a year, and we fear that we would see a substantial decline in subscriptions at that level. So until we can think of some other way of financing the magazine I'm afraid we have to stay quarterly.
Basically BASIC has been a very popular series. Parts 1 to 9 appeared in the March to November 1981 issues of "Electronics and Music Maker", back issues of which are still available. However, when the series is completed we hope to republish the whole thing in book form.

MES56 Again

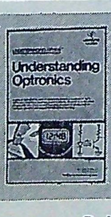
Dear Sir,
Congratulations on your 1st and 2nd editions of your magazine. It was very nice to see an interest taken in the Matinee update, which must prove very useful to readers building that organ. Would it be possible to do the same thing with the MES50 series organ which seemed to come to an abrupt halt with MES55. There must be more people than just yours truly still trying to build this organ, or even current owners who would like the goodies promised in the yet to be published MES56, nor the apparently now still-born MES57. This is quite an expensive project for most of us (£1,200+) for it not to have a piano voice etc.
Or has some enterprising reader added this on and would like to tell us how he did it? Personally, I am still trying to work out what could go on the "Y" pins on the tone boards.
Good luck for the future and really keep the musical side going.

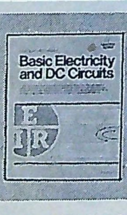
N. SYLVESTER
Bexhill-on-Sea, Sussex

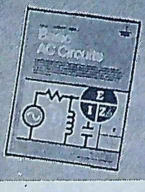
See the answer to Mr Manzie's letter. The Y pins on the tone boards were provided in case they were needed for the couplers, but they are not required at this stage.

TEXAS INSTRUMENTS DATA LIBRARY

(continued from page 53)







Understanding Computer Science
by Roger S. Walker
Explains the science of how people use computers to solve problems. Covers the fundamentals of hardware, software and applications including program design, languages, data structures and resource management. Written in easy-to-understand language with basic concepts illustrated by practical applications.
1981. 278 pages. 208 x 132mm. Illustrated.
Order As WA25C (Underst Comp Science) Price £4.95*NV*

Understanding Optronics
by Larry B. Masten and Billy R. Masten
What is light and where does it come from? Starting with these questions the book goes on to explain why and how opto-electronic devices work. Such devices as LED's, liquid crystal displays, CRT's etc. Fibre optic links and lasers are also explained.
1981. 272 pages. 208 x 132mm. Illustrated.
Order As WA26D (Understanding Optronics) Price £4.95*NV*

Basic Electricity and DC Circuits
by Ralph A. Oliva and Charles W. Dale
A step by step approach for the beginning student. The book covers first concepts and terms, basic mathematics required in the study of basic electricity and direct current circuits. This is a comprehensive text including clearly stated objectives and exercises with answers and is ideal for self-paced individualised learning.
1979. 924 pages. 234 x 184mm. Illustrated.
Order As WA27E (Basic Elec & DC Ccts) Price £12.50*NV*

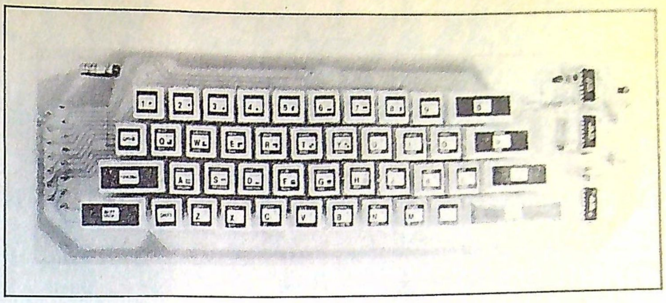
Basic AC Circuits
by Stanley R. Fulton and John Clayton Rawlins
Continuing the series begun in 'Basic Electricity and DC Circuits', this book goes on to explain simple and complex AC circuits. As with the first book, it is a very comprehensive text and each new concept is carefully explained as it is introduced.
1981. 560 pages. 234 x 184mm. Illustrated.
Order As WA28F (Basic AC Circuits) Price £10.95*NV*

ZX81 KEYBOARD

Continued from page 4

delaying the operation of IC1c. When it finally operates, it turns on IC3c which connects 'function' in the keyboard matrix. These time delays are provided to ensure that the 'shift' connection occurs before the 'graphics' or 'function' connection as required by the ZX81.

When S33, the 'shift lock' key is operated, the output of IC1e goes high. C3 and R4 are anti-bounce components. IC2a now operates which switches on IC3b via D3 and TR2 which causes LED2 to light. Re-operating S33 causes IC2a output to go low which releases IC3b and extinguishes LED2. ■



PARTS LIST

Resistors — all ⅓W 5% carbon unless specified			
R1	150k		(M150K)
R2,3,6	1M	3 off	(M1M)
R4,7	100k	2 off	(M100K)
R5,8,9	10k	3 off	(M10K)
R10,11	560R	2 off	(M560R)
Capacitors			
C1	390nF polycarbonate		(WW48C)
C2,3,4,5	100nF polycarbonate	4 off	(WW41U)
C6	10nF polycarbonate		(WW29G)
C7,8,9,10	100nF minidisc ceramic	4 off	(YR75S)
C11	100uF 25V axial electrolytic		(FB49D)
Semiconductors			
D1-6	1N4148	6 off	(QL80B)
LED1,2	LED red	2 off	(WL27E)
TR1,2	BC548	2 off	(QB73Q)
IC1	40106BE		(QW64U)
IC2	4027BE		(QX16S)
IC3	4066BE		(QX23A)
Miscellaneous			
JK1	Plug 3.5mm plastic		(HF80B)
S1-44	Keyswitch	44 off	(FF61R)
	Keytop 1-position	37 off	(FF62S)
	Keytop 2-position	5 off	(FF63T)
	Keytop 3-position		(FF64U)
	Keytop print ZX81		(XH58N)
	ZX81 ext. keyboard pcb		(GA83E)
	Tinned copper wire 24 swg	2m	(BL15R)
	Adaptor L		(RK27E)
	RA flexiconnector 5-way		(RK28F)
	RA flexiconnector 8-way		(RK29G)
	Flexicable 7-way		(RK30H)
	Flexicable 10-way		(RK31J)
	Cable single black	½m	(XR12N)

A complete kit for this project excluding a case is available
Order As LW72P (ZX81 Keyboard Kit) Price £19.95
A case is also available.
Order As XG17T (ZX81 Keyboard Case) Price £4.95

25W STEREO MOSFET AMP

Continued from page 44

PARTS LIST

Resistors — all ⅓W 5% carbon unless specified			
R1,6	68k	2 off	(M68K)
R2,7,37,48	1k	4 off	(M1K)
R3,8	22k (1%)	2 off	(T22K)
R4,9	270k (1%)	2 off	(T270K)
R5,10	100k	2 off	(M100K)
R11,12,40,41, 51,52	100R	6 off	(M100R)
R13,16,17,20	470k	4 off	(M470K)
R14,18	1k2	2 off	(M1K2)
R15,19	22k	2 off	(M22K)
R21-24,27-32	2k2	10 off	(M2K2)
R25,26,39,50	15k	4 off	(M15K)
R33,44	47k	2 off	(M47K)
R34,45	56k	2 off	(M56K)
R35,36,46,47	3k9	4 off	(M3K9)
R38,49	33k	2 off	(M33K)
R42,43,53,54	10R	4 off	(M10R)
R55,56	220R (½W)	2 off	(S220R)
R57,58	820R	2 off	(M820R)
R59	2k7		(M2K7)
RV1-4	100k horizontal sub-min preset	4 off	(WR61R)
RV5,6	10k horizontal sub-min preset	2 off	(WR58N)
RV7	4k7 log dual pot		(FX08J)
RV8,9	47k lin dual pot	2 off	(FW87U)
RV10	10k lin pot		(FW02C)
Capacitors			
C1,5	68pF ceramic	2 off	(WX54J)
C2,6,25,31	10uF 35V PC electrolytic	4 off	(FF04E)
C3,7	10nF 1% polystyrene	2 off	(BX86T)
C4,8	3n9 1% polystyrene	2 off	(BX63T)
C9	100uF 40V axial electrolytic		(FB50E)
C10,11	10uF 16V tantalum	2 off	(WW68Y)
C12,13,23,29	10pF ceramic	4 off	(WX44X)
C14,15,18,19	68nF polycarbonate	4 off	(WW39N)
C16,20	4n7 polycarbonate	2 off	(WW26D)
C17,21,24,26, 30,32	47pF ceramic	6 off	(WX52G)
C22,28	4uF 16V tantalum	2 off	(WW64U)
C27,33	100nF polyester	2 off	(BX76H)
C34,35	100uF 25V axial electrolytic	2 off	(FB49D)
C36,37	4700uF 40V axial electrolytic	2 off	(RK26D)
Semiconductors			
D1-4	1N4148	4 off	(QL80B)
D5,6	BZY88C15V	2 off	(QH18U)
LED1	Chrome LED small		(YY59P)
BR1	Bridge S04		(QL10L)
TR1,2,3,8,9,10	BC212L	6 off	(QB60Q)
TR4,5,11,12	BC182L	4 off	(QB55K)
TR6,13	2SK133	2 off	(QQ36P)
TR7,14	2SJ48	2 off	(QQ34M)
IC1,2,3	LF353	3 off	(WQ31J)
Miscellaneous			
S1	Rotary mains switch		(FH57M)
S2	Rotary 3-pole 4-way switch		(FH44X)
SK1,2,3	PC DIN socket 5-pin 'A'	3 off	(YX91Y)
SK4,5	PC DIN socket 2-pin	2 off	(YX90X)
JK1	DPDT jack socket		(BW80B)
T1	Toroidal transformer 22V 80VA		(YK18U)
FS1,2,3	2A antisurge fuse	3 off	(WR20W)
	Safuseholder 20mm		(RX96E)
	Rubber boot		(HL51F)
	Fuse clips	4 off	(WH49D)
	Mica insulator T03	4 off	(WR24B)
	Small thermpath		(HQ00A)
	Stereo amp heatsink		(RK25C)
	Stereo amp pcb		(GA71N)
	Stereo amp switch pcb		(GA78K)
	Stereo amp chassis		(XG15R)
	Stereo amp woodwork		(XG16S)
	Cabinet feet	1pk	(FW19V)
	Grommet small	2 off	(FW59P)
	Knob K44	3 off	(HB39N)
	Knob K45		(HB40T)
	Knob K46	2 off	(HB41U)
	Veropin 2141	28 off	(FL21X)
	Bolt 4BA 1in	4 off	(BF04E)
	Bolt 6BA ¼in	5 off	(BF05F)
	Bolt 6BA ½in	8 off	(BF06G)
	Nut 6BA	13 off	(BF18U)
	Washer 6BA	12 off	(BF26D)
	Tag 6BA		(BF29G)
	13A mains plug		(RW67X)
	Min mains cable	2m	(XR01B)
	Hook up wire yellow	1m	(BL10L)
	Tinned copper wire 24 swg	1m	(BL15R)
	Systoflex 2mm black	10cm	(BH06G)

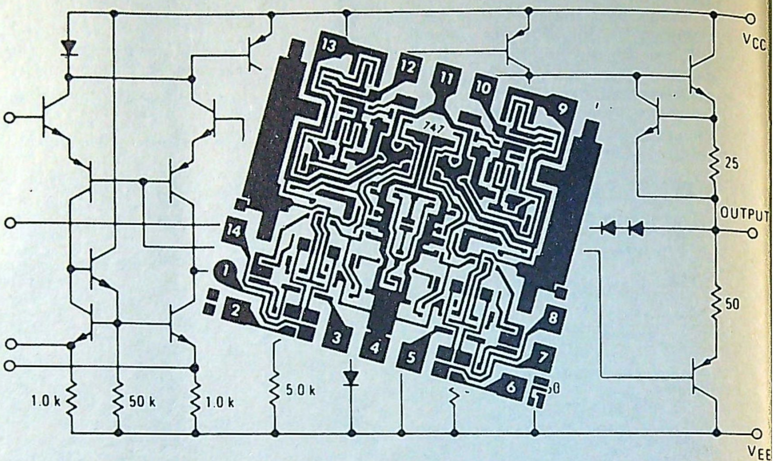
A complete kit of all the parts listed above is available.
Order As LW71N (25W Stereo MOSFET Amp Kit) Price £49.95

WORKING WITH OP~AMPS

by *Graham Dixey C.Eng., M.I.E.R.E.*

Part 2

The first part of this series introduced the op-amp and gave an insight into its versatile nature. Now its specific role as a waveform generator will be illustrated. The most useful waveforms are undoubtedly the sine-wave, square-wave, triangle and sawtooth, all of which can be produced by this device. As a result, it will be appreciated that what is being demonstrated is not only its linear use for generating sine-waves but also its switching mode when giving a square-wave output.



The Astable Multivibrator

This circuit (Figure 1) looks unfamiliar when compared with the discrete component equivalent. One obvious difference is that there is only one RC 'timing' circuit (R1, C1). This saves components but means that the mark to space ratio of the square-wave output will always be 1:1. Adjusting either R1 or C1 only changes the frequency. The resistors R2 and R3 form a potential divider between the output and the 0V line so that, whatever level exists at the output (+Vs or -Vs), the non-inverting (+) input is always at a fixed proportion of it.

The clue to the mode of operation lies in this last statement. The non-inverting input is held at a fixed reference voltage, either positive or negative, while at the instant that power is applied to the circuit, the inverting input is at 0V since C1 is uncharged. As a result, the output goes to either +Vs or -Vs (it does not matter which, say +Vs), in which case the non-inverting input will be at a potential equal to +Vs [R3/(R2 + R3)]. Since there is zero phase-shift between this input and the output, the latter level is effectively 'latched' to +Vs. The circuit is now resting in one of its two 'quasi-stable' states and will do so until something upsets the equilibrium. This 'something' will occur when the exponentially rising voltage at the junction of R1 and C1 reaches the potential of the non-inverting input. Then, as this exponential voltage just becomes slightly more positive than the latter potential, the circuit will start to change state. The op-amp's very high gain ensures that the output switches rapidly from +Vs to -Vs and the potential at the non-inverting input will now reverse its polarity, latching the circuit into the new state.

The current flowing in R1 also changes direction so that the potential of the inverting input begins to fall exponentially from +Vs [R3/(R2 + R3)] towards -Vs. However, when it reaches -Vs [R3/(R2 + R3)], the circuit switches back into its original state and the cycle repeats indefinitely.

The time for which the circuit remains in one state is governed by the time constant of R1 and C1 and the voltage at the junction of R2 and R3. Frequency can, therefore, be controlled in a number of ways: by using a potentiometer for R1 and/or switching the value of C1 to give several ranges, or using a resistor chain with a potentiometer instead of R2 and R3, so varying the point in time at which the circuit changes states.

With the exponential law of growth as a basis, it is a fairly easy matter to derive an expression for frequency in terms of R1, R2, R3 and C1, thus stating precisely how frequency depends upon these circuit constants.

The time between instants of switching is found to be given by:

$t_s = C1.R1.\log_e [1 + (2R3/R2)]$

and $f = 1/(2t_s)$

C1(nF)	Frequency (Hz) Measured	Frequency (Hz) Calculated	Error
10	1190	1371	-13%
47	290	292	-0.7%
100	143	137	+4.4%
220	65	62.3	+4.3%
470	30.8	29.2	+5.5%
1000(1u)	14.3	13.7	+4.4%

Table 1. Frequency vs. timing capacitor value for the circuit shown in Figure 1.

Having derived this expression for frequency, the next step was to verify it. Close tolerance resistors (5%) were used for R1, R2 and R3 and values of C1 were set on a decade capacitor box, so as to give the results some credibility. The values chosen for the resistors were R1 = R2 = 100k and R3 was 22k. The results obtained are shown in Table 1, which also includes the calculated values of frequency and the percentage errors. Except at the highest frequency, the errors are within acceptable limits. Therefore, for generators up to a few hundred Hertz, the formula can be used with confidence.

A limitation of the 741 is its inability to switch rapidly between opposite states. This limit is expressed in op-amps by the 'slewing rate', which is given in V/us. Figure 2 shows that slewing rate is simply the slope of voltage/time as the output tries to swing from one saturation level to the other. For the 741 the maximum slewing rate is usually quoted as 0.5V/us so that, with a ±15V supply, a complete transition from, say, -15V to +15V cannot be achieved in less than 30 x 0.5 = 15us, in the best case. Since switching circuits are being discussed, it is as well to be aware of possible limitations. For example, the astable circuit of Figure 1 while producing an acceptably square waveform at 1kHz, showed a marked slope on the leading and trailing edges at 5kHz.

Figure 3 shows a slightly modified form of

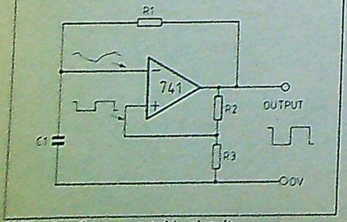


Figure 1. Op-amp astable circuit.

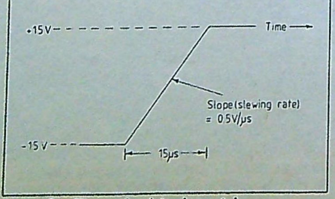


Figure 2. Illustrating 'slewing-rate'.

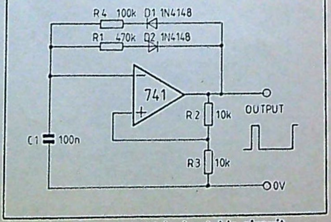


Figure 3. Non-symmetrical astable circuit.

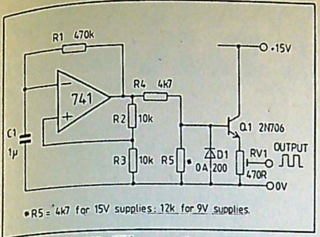


Figure 4. A 1Hz TTL generator.

the astable circuit, in which the restriction of a unity mark to space ratio has been lifted. This is achieved by placing diodes D1 and D2 in the feedback paths so that the polarity of the output voltage selects which of the feedback resistors is in circuit on a particular half-cycle. This gives two time constants which are quite independent of each other — R4, C1 on positive half-cycles and R1, C1 on negative half-cycles. With the values shown this gives a short mark and a long space of 11ms and 52ms respectively.

A 1Hz TTL Generator

For digital experiments a low frequency square-wave generator is very useful, for example, for testing counters and shift registers. An output at about 1Hz is slow enough to allow events to be observed with ease and, using the op-amp astable circuit, a frequency of this value is easily achieved without the need for excessively large capacitor values.

The design is straightforward. As a starting point, let R2 = R3 = 10k (quite an arbitrary choice, which could be adjusted later if necessary). The only other components to be decided now are the timing components and it is convenient to choose a value of capacitance first, then work out the corresponding resistor value; this allows greater freedom of choice in component values. The largest value of non-electrolytic capacitor is about 1uF, so this value is used with the previously derived formula to obtain the resistor value. The formula then looks like this:

$t_s = 0.5 = 10^{6} \times R1 \times \log_e$ (at 1Hz $t_s = 0.5$ secs.)
from which R1 = 455K

The nearest preferred value is 470k, which actually gives a frequency of 0.97Hz (neglecting component tolerances), which should certainly be close enough for most purposes. In fact, when the circuit was wired up, using 5% resistors and a 10% polyester capacitor, the error from the design value of 1Hz was too small to measure.

The next step, after getting the circuit to perform at the right frequency, is to make it TTL compatible, which means converting a ±14V swing about 0V (the output does not quite reach 15V) into a wholly positive 5V square-wave. A few additional components lead to the final circuit of Figure 4, which shows the attenuation of the op-amp output (R4 and R5) to a total swing of about 6V, this then being 'clamped' to 0V by the action of Q1, which also 'buffers' the output to provide enough drive for a number of TTL circuits. Diode D1 also has a clamping action, but its true purpose is to protect the base-emitter diode of Q1 against excessive negative V_{BE} on negative going output swings of the op-amp. The emitter resistor of Q1 is a potentiometer (preset) so that the amplitude of the output can be adjusted to precisely 5V.

Obviously the generator could be made to produce a range of frequencies by switching different values of R1 or C1.

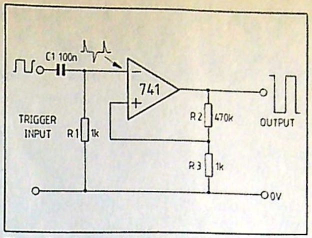


Figure 5. Op-amp bistable circuit.

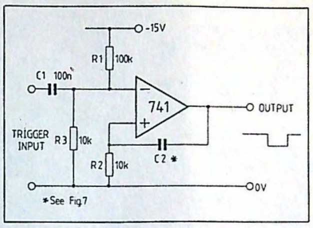


Figure 6. Op-amp monostable circuit.

The Bistable Multivibrator

Bistable action may not normally be associated with the op-amp, i.e. a circuit which is capable of resting indefinitely in one of two stable states. But, as was seen with the astable circuit, feedback from the output to the non-inverting input, will latch the circuit into a state of either positive or negative saturation. If, meanwhile, the inverting input is held at 0V, the circuit stays in this state until a trigger of some sort causes a change of state. This trigger is applied to the inverting input and the only stipulation is that its peak value must exceed the voltage at the non-inverting input; the circuit will even trigger on sine-wave inputs.

Figure 5 shows such a circuit. The inverting input is held at 0V by resistor R1 while the non-inverting input is taken back to the junction of the divider R2 and R3 across the output. Thus, depending upon the current state of the circuit, the bistable is latched into this state by a voltage at the non-inverting input equal to ±R3/(R2 + R3) x output voltage. For the values given and a ±15V supply, this voltage is (1/471) x 14, which is approximately 30mV, more than enough to take the circuit into saturation.

The trigger input is capacitively coupled to the inverting input by C1 which, with R1 differentiates the input if it is a pulse or square waveform. This action produces a series of alternate positive and negative trigger pulses which, coinciding as they do with the leading and trailing edges of the original square-wave input, mean that the output is at the same frequency as the input but reversed in phase and of larger amplitude. There is no 'divide-by-two' action and the circuit acts effectively as a 'pulse amplifier'.

This bistable circuit is not particularly fast; frequencies up to about 300Hz give a good square-wave output but, thereafter, the risetime suffers markedly.

Returning to the absence of an inherent divide-by-two action, this limitation can be removed if R2 is replaced by a parallel RC combination consisting of a 1M resistor and a 100nF capacitor, and R3 is replaced by a 470k resistor. The 100nF capacitor introduces a time constant whose purpose is to ensure that, when the circuit is initially switched, say, by the leading edge of a square pulse, it does not change state again on the trailing edge of that pulse but 'waits' for the leading edge of the next pulse. The value of 100nF is large enough for pulses up to 50ms in length but needs to be increased for longer pulses.

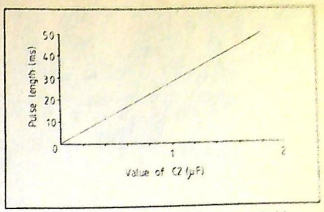


Figure 7. Pulse length graph for monostable circuit shown in Figure 6.

The Monostable Multivibrator

This, the last of the 'trio' of multivibrator circuits, has one stable state (in which it rests until triggered) and one 'quasi-stable' state (in which, after triggering, it remains for a pre-determined time, decreed by circuit constants). Although monostables can be realised with discrete components or obtained in TTL integrated circuits, it may now be appreciated that this circuit can also be produced with the ubiquitous op-amp. In this form it appears in Figure 6.

For a monostable to exist in a stable state, there must be a bias holding the circuit in that state. This bias is provided by taking the inverting input to -15V through resistor R1. The output of the op-amp is, therefore, normally in positive saturation. It is then triggered into the quasi-stable state by a square-wave or pulse input. This is differentiated by C1 and R3, only the positive pulses produced having any effect on the circuit. As a result, the circuit switches over to negative saturation where it is held by the large negative potential instantly coupled back to the non-inverting input by C2. Of course, this state cannot be sustained for long because, at this initial instant, the full negative supply voltage exists across R2 so that a charging current flows through R2 and the potential of the non-inverting input rises exponentially towards 0V. When it reaches the same value of negative voltage as at the inverting input (about -1.4V), the circuit switches back to positive saturation.

The time constant for the recovery is CR, R2 and it is possible to derive a formula for the length of the positive pulse produced at the output as a result of this action. However, in this circuit, unlike the astable, there is a linear relationship between pulse length and capacitance value so that a useful graph can be plotted between these two quantities (Figure 7). This covers a range of pulse lengths from 0 to 50ms, corresponding to values of C2 in the range 0 to 2uF. Obviously the range can be extended further by using higher values of C2 or a higher value of R2.

This type of circuit functions as a 'pulse-stretcher'; a short pulse is used to generate a much longer pulse. Or it can be used as a regenerator of pulses since the input waveform is not too critical provided that it can cause the required change of state, but the output pulse will always be of good square form.

As waveform generators, these multivibrators all generate square-waves in one way or another; each has its own use. Op-amps can also be used to generate 'derived' waveforms, such as the triangle and sawtooth; they can also be used in sine-wave oscillators. Generators of these types will be the subject of the next article. ■

ATARI COMPUTER NEWS

by Graham Daubney

This has been a very busy period for those of us involved in computers here at Maplin. I'm sure that most of you will have heard by now that Ingersoll are no longer handling Atari products in the U.K. and that all Atari products are now being distributed by Atari themselves.

The change-over has been in the air for some time and I first heard rumours on the grapevine just before Christmas. Obviously a major change of this nature took several months for the parties involved to negotiate and the news was made official during March.

We are pleased to see that the computer press are now taking the Atari seriously and there are many articles and features lined up for future issues.

The move made by Atari to distribute their own product means several things, firstly and most importantly, a number of facilities are being set up to support the machine both for hardware and software areas. This does not directly affect you as a customer, but indirectly it has a great bearing on the Atari's future in this country as it offers both software houses and developers assistance and better backup for the U.K. retailers.

You may have already noticed a new TV campaign on the VCS games console and due to start shortly is a large scale support program for the home computer system as well.

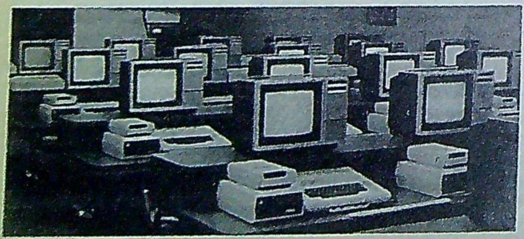
Atari Program Exchange software will be on sale in the U.K. by mid-May which is good news as although many of these titles are available from some locations in the U.K., the prices are at present a little inflated due to importation in small quantities.

I feel that the next quarter will see a maturing of the Atari market and from the discussions that we've had with Atari I can assure you that this move will be for your benefit and that Atari mean business.

Left to right: Jeff Burton, Assistant International Marketing Director of Atari; Roger Allen, Managing Director of Maplin; Graham Daubney, Computer Manager of Maplin; Fred Mitchell, International Sales Director of Atari pictured in Atari's spectacular headquarters at Sunnyvale, California.

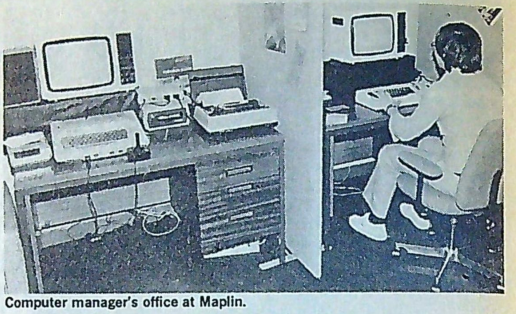
Atari in California

Besides all the Ingersoll-Atari goings-on, this quarter has seen many other activities here at Maplin. In January I made a further trip to California to visit the C.E.S. show in Las Vegas and also to Sunnyvale the birth place of Atari. During this trip I found many new items of software both from Atari and third party software developers. Some of these we have added to our extensive list already, but many more are planned. At the C.E.S. show I was given a sneak preview of both Pac-Man and Centipedes cartridges that are to be launched by Atari in the second quarter (remember you have to add 3 months because Atari calculate their launch dates whilst sitting in a time slip!!!).



The Atari 800 training room at Sunnyvale, California.

Whilst at Sunnyvale I visited the International Marketing Division and discussed the needs of the U.K. market in some depth. Atari's offices have to be seen to be believed, with fountains galore and very pleasant settings to work in. Further to those meetings I was able to meet the User Group Support Division and register our Users Group.



Computer manager's office at Maplin.

Atari Users Group

February saw three of us here late in the evenings writing the first issue of the user group mag. We now have over 300 members and are getting some very valuable feedback as to what you want the user group to offer.

March saw the installation of a new member of staff in our sales office to deal with your machine enquiries and problems and the arrival of a VIC 20 in the office!

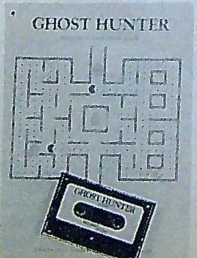
MODEL NO. ATR1000
K-RAZY SHOOT OUT
BYTE
AN EXCITING, FAST-ACTION GAME FOR ATARI HOME COMPUTERS
CONTAINS: ONE ROM CARTRIDGE ONE INSTRUCTION BOOKLET
ACCESSORY REQUIRED

K-razy Shoot Out

Whilst in America, a new cartridge for the Atari computer systems was launched. The difference with this cartridge is that it was not developed by or manufactured by Atari. K-razy Shoot Out is the first third-party cartridge to be launched for the machine and won't be the last by all accounts. K-razy Shoot Out is a fast action game for one player. You are trapped in a series of rooms, with nasty little robots who shoot at you and converge on you. Points are scored by first staying alive (not easy I assure you) and secondly by shooting all the robots in the room. Problem is that when you have cleared a room and have run out, another room appears with more of the deadly assassins and, yes, you guessed it this time they shoot faster and move faster. If any of you get past the sixth room you will be doing very well! The graphics on this game are very good and because each room is randomly generated it doesn't allow the development of a 'technique' and this leads to many frustrated hours of fun, but be warned this game is totally addictive.

Order As BQ63T (K-razy Shoot Out) Price £29.95

See outside back cover for details.



Ghost Hunter

Another game based on the ever popular maze chase theme has been launched called Ghost Hunter. The main advantage of this version over previous maze chase games is that it gives you many options and choices. The layout of the maze is selectable and also you may have two players 'head to head' i.e. both in the maze together. This adds a lot of cunning and much hostility as you compete together against the marauding ghosts.

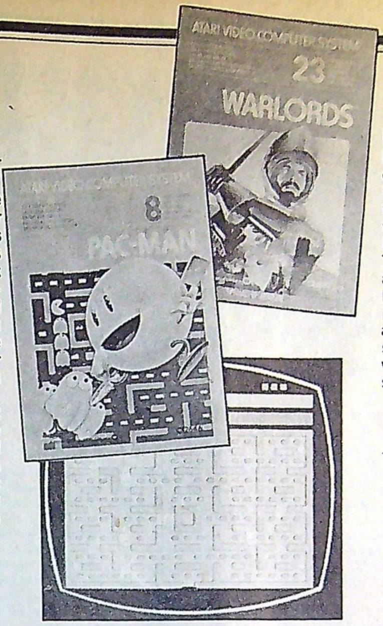
Order As BQ64U (Ghost Hunter) Price £24.50

See outside back cover for details.

ATARI VIDEO GAME

Latest Cartridge Details

This month, details of three new cartridges.



Warlords

For one to four players using paddles. Note that a second pair of paddles is needed for three or four players. The cartridge contains 23 games. You are one of four Warlords behind your castle wall. You must break down your opponents castles by firing fireballs, then you can aim to hit the Warlord himself. There are four sets of five games. In each set, the first game is for one player, the second for two, third for three, fourth for four and the fifth game is for two players controlling two castles each.

In the first set of games, the ball speed is fast and the shields catch the balls, whilst in the second set the ball speed is slow. In the third set the ball speed is fast, but the balls ricochet off the shields and in the fourth set the ball speed is slow again. Games 21 to 23 are special versions for four, three or two children respectively. You will find that four-player games are terrific because the action is fierce and extremely competitive.

Order As AC44X (Warlords) Price £29.95

Pac-Man

For one or two players using joysticks, this game cartridge contains eight games. Pac-Man moves around a maze eating the video wafers. Four ghosts chase him and try to eat him up. However, located in the maze are four power pills, which when eaten by Pac-Man allow him to eat the ghosts.

In games 1, 2, 7 and 8 Pac-Man moves slowly whilst in the remainder, he is fast-moving. In games 1 and 5 the ghosts move at jogging speed, in games 2 and 6 they move at running speed, in games 3 and 7 at crawling speed and in games 4 and 8 at walking speed. Games 3 and 7 are ideal for children, whilst game 6 is the most difficult variation.

Order As AC68Y (Pac-Man) Price £29.95

Haunted House

For one player using a joystick controller, this cartridge contains four different games. In this exciting game, players must search through a multi-storey, haunted mansion with many, many rooms to find pieces of long-lost treasure and get out again alive. There are giant tarantulas, vampire bats and a ghost to contend with and you need to keep lighting the match to see the objects you need. There are three pieces of a magic urn, a master key to move through doors and a silver cross to keep monsters at bay. And watch out for the secret passage, it could save your life.

**Order As AC69A (Haunted House)
Price £18.95**

ATARI VIDEO GAME COMING SOON

The following titles are due to be released during the life of this magazine. Full details in our next issue.

AC70M	**From Demons To Diamonds**	**Price £18.95**
AC71N	**Yar's Revenge**	**Price £29.95**
AC72P	**Berzerk**	**Price £29.95**
AC73Q	**Defender**	**Price £29.95**
AC74R	**Adventure I**	**Price £24.95**
AC75S	**Adventure II**	**Price £24.95**
AC76H	**Raiders Of The Lost Ark**	**Price £29.95**

ATARI COMPUTER NEWS *(continued from page 58)*

Coming Soon

Lastly, a few explanations are necessary. Firstly, where is Jumbo Jet Lander and Sub-Commander. You may well ask and I only wish I knew. It appears that both of these products were announced far too early to yourselves, the press and us and I must apologise for the delay, even though it's not our fault. The latest news is that both are now in a playable condition and they are still coming down the pipeline. Those of you who have placed orders will receive your software the minute it is available.

Where are the Tech User Notes? — a question I have been asking for several months. It appears that the Americans are not as inquisitive as us English types and rarely buy the things. Thus Atari were caught with their slacks down! However, with the advent of the U.K. Division of Atari we have negotiated what I feel is an amicable solution and I hope you will agree. All those people waiting for Tech Notes will now receive De Re Atari. Although there is some information in the Tech Notes that is not in De Re Atari, the latter is a far better publication to learn from and offers very good explanations of a player missile graphics, scrolling, display list interrupts, vertical blank interrupts and the section on sounds has to be seen to be believed. I hope this arrangement will be acceptable to the majority of you and anyone who is unhappy at the prospect of receiving the world's most sought after Atari publication will of course be suitably reimbursed. I am still trying to locate Tech User Notes and we will do our best to come up with some news for the next Quarterly.

ATARI PRICE CHANGES

We regret that owing to Atari restructuring their price list after the cover of this magazine was printed, some of the prices on the back cover are incorrect.

Hardware

AF02C	The £599 price is strictly while stocks last, then the price will revert to:	£645
AF08J	64K RAM Module	£65.00
AF28F	Cassette Recorder	£50.00
AF36P	The £299 price is strictly while stocks last, then the price will revert to:	£345
AF41U	Printer Interface for 400	Price £59.95
AF42V	Printer Interface for 800	Price £59.95

Software

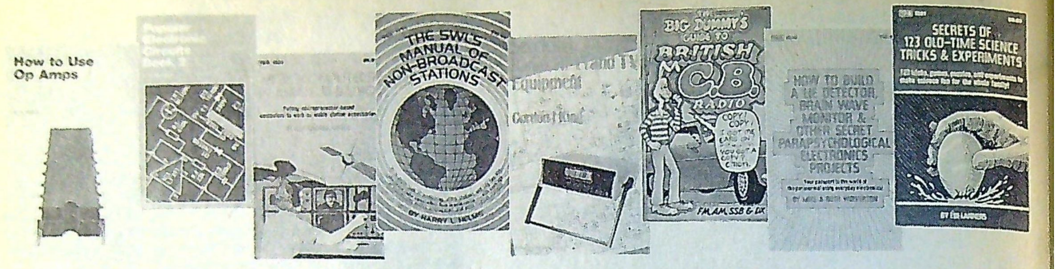
YG42V	Word Processor	Price £99.95
YG43W	Invitation To Programming 1	Price £15.95
YG44X	Conversational French	Price £39.95
YG45Y	Conversational German	Price £39.95
YG46A	Conversational Spanish	Price £39.95
YG47B	Conversational Italian	Price £39.95
YG48C	Music Composer	Price £35.95
YG49D	Touch Typing	Price £15.95
YG51F	Graph-It	Price £13.95
YG52G	Statistics	Price £13.95
YG53H	Energy Czar	Price £9.95
YG54J	Hangman	Price £9.95
YG55K	Kingdom	Price £9.95
YG56L	States & Capitals	Price £9.95
YG57M	European Capitals	Price £9.95
YG58N	Scram	Price £17.50
YG59P	Telelink	Price £21.50
YG61R	Basketball	Price £24.50
YG62S	Blackjack	Price £9.95
YG63T	Chess	Price £24.50
YG67X	Super Breakout	Price £24.50
YG68Y	Assembler Editor	Price £39.95
YG69A	Pilot (Consumer)	Price £54.00
YG70M	Space Invaders	Price £29.95

NEW PROGRAMS FOR ATARI AVAILABLE SOON

BQ65V	Personal Financial Management	Price £49.00
BQ66W	Mortgage & Loan	Price £13.95
BQ67X	Invitation To Programming 2	Price £22.95
BQ68Y	Invitation To Programming 3	Price £22.95
BQ69A	Caverns Of Mars	Price £24.50
BQ70M	Centipede	Price £29.95
BQ71N	Pac-Man	Price £29.95
BQ72P	Video Easel	Price £24.50
BQ73Q	Macro Assembler	Price £59.95
BQ74R	Microsoft Basic	Price £59.95
BQ75S	Pilot (Educator)	Price £79.95

More details in our next issue or telephone our sales office.

NEW BOOKS *(continued from page 45)*


How to Use
Op Amps
THE SWL's MANUAL OF NON-BROADCAST STATIONS
BIG DUMMY'S GUIDE TO BRITISH CB RADIO
FM, AM, SSB & DX
HOW TO BUILD A LIE DETECTOR, BRAIN WAVE MONITOR & OTHER SECRET PARAPSYCHOLOGICAL ELECTRONICS PROJECTS
SECRETS OF 123 OLD-TIME SCIENCE TRICKS & EXPERIMENTS

How to Use Op-Amps
by E. A. Parr

This designers guide covering many operational amplifiers, serves as a source book of circuits and a reference book for design calculations. The book covers basic circuits, oscillators, audio circuits, filters, power supplies and a large selection of miscellaneous circuits. There is also a short section of constructional notes and fault finding details.
1982. 160 pages. 176 x 110mm. Illustrated.
Order As WA29G (Book BP88)
Price £2.25

Popular Electronic Circuits Book 2
by R. A. Penfold

A further 73 projects to build covering a wide range of subjects. Chapter headings are: audio circuits, test gear circuits, radio circuits, house and car circuits and miscellaneous circuits. The book is suitable for those capable of building projects from just a circuit diagram, although a description of how it works and any testing or setting-up information is given.
1982. 160 pages. 180 x 108mm. Illustrated.
Order As WG86T (Book BP98)
Price £2.25*NV*

Microcomputers In Amateur Radio
by Joe Kasser, G3ZCZ

The book describes how to use a computer as an accessory in an amateur radio station. Interfaces are described and programs are shown. Morse code generation and RTTY software are shown. The book is of interest to any amateur radio operator who wants to tune in to the latest technical innovations. American book.
1981. 308 pages. 208 x 130mm. Illustrated.
Order As WG95D (Book FT1305)
Price £7.45*NV*

The SWL's Manual Of Non-Broadcast Stations
by Harry L. Helms

From the basics of propagation to logging and verification this book shows you how to pick up non-broadcast stations all round the world. Listen to spy stations, standard time transmissions, aeronautical and space communications bands. An absolute wealth of information for SWL's. American book.
1981. 272 pages. 208 x 130mm. Illustrated.
Order As WG93B (Book FT1235)
Price £9.45*NV*

Servicing Radio, Hi-Fi and TV Equipment
by Gordon J. King

The book deals with servicing domestic electronic equipment with the emphasis on speedy fault diagnosis. Semiconductor principles and circuitry are described and fault diagnosis in various types of circuits is covered. The book contains much practical advice and is invaluable to the service engineer, students and the hobbyist presented with faulty equipment.
1982. 216 pages. 216 x 138mm. Illustrated.
Order As WG89W (Book NB132)
Price £7.95*NV*

The Big Dummies Guide To British CB Radio

Contains the latest information about FM, AM, SSB, skip and DX ing. The book covers buying and installing a rig and antenna, troubleshooting, Home Office regulations, do-it-yourself antennae and emergency procedures. Included are new charts, codes, graphs and reference guides designed to help you get out.
1981. 160 pages. 216 x 134mm. Illustrated.
Order As WG97F (Book KN035)
Price £3.85*NV*

How To Build A Lie Detector, Brain-Wave Monitor & Other Secret Parapsychological Electronic Projects
by Mike and Ruth Wolverton

All of the projects in this unique and unusual book were taken from recent scientific research in the field of parapsychology. Full instructions are given, showing how to build a simple telepathic message receiver and an inexpensive brain-wave monitor. You can build biofeedback projects, control psychokinetic energy, perform electronic dowsing. In addition Kirlean photography is explained and details are given for building a UFO detector and communicator. American book.
1981. 308 pages. 208 x 130mm. Illustrated.
Order As WG94C (Book FT1349)
Price £9.45*NV*

Secrets Of 123 Old-Time Science Tricks & Experiments
by Edi Lanners

A unique and fascinating book that explains and shows you how to perform amazing feats. You won't need any fancy equipment; the book shows you how to set up the experiments and illusions using ordinary household objects. American book.
1981. 192 pages. 208 x 130mm. Illustrated.
Order As WG91Y (Book FT1261)
Price £5.45*NV*

NEW ITEMS PRICE LIST *(continued from page 37)*

GA62S	Timer Switch Board	Price £3.85
GA63T	Timer Relay PCB	Price £1.10
GA64U	Timer Front Panel	Price £3.85
GA66W	Stereo Reverb PCB	Price £2.45
GA67X	Soft Distortion PCB	Price £1.95
GA68Y	Quadramix PCB	Price £1.15
GA72P	Train Common PCB	Price £2.90
GA73Q	Train Control PCB	Price £2.20
GA74R	Train Receiver 1 PCB	Price £1.35
GA75S	Train Receiver 2 PCB	Price £1.35
GA76H	MPG Meter Main PCB	Price £2.45
GA77J	MPG Meter Display PCB	Price £1.75
LW51F	75W Mosfet Amp Kit	Price £11.49
LW52G	Wordmaker Kit	Price £99.95
LW53H	5600S Synthesiser Kit	Price £599.95 Carriage extra £20.00
LW54J	3800 Synthesiser Kit	Price £336.75 Carriage extra £20.00
LW55K	Synclock Kit	Price £19.75
LW57M	Burglar Alarm Kit	Price £44.95
LW58N	External Horn Kit	Price £29.95
LW59P	Break Contact Kit	Price £2.99
LW60Q	Spectrum Synth Kit	Price £167.50
LW61R	Train PSU/Common Kit	Price £27.50
LW62S	Train Control Kit	Price £6.45
LW63T	Train Receiver 1-ML926 Kit	Price £5.95
LW64U	Train Receiver 2-ML926 Kit	Price £5.95
LW65V	Stopwatch Kit	Price £34.95
LW67X	MPG Meter Kit	Price £44.95
LW68Y	Train Receiver 1-ML927 Kit	Price £5.95
LW69A	Train Receiver 2-ML927 Kit	Price £5.95
XG03D	Combo Amp Front Panel	Price £3.35
XG05F	Matinee Modular Organ Kit	Price £399.45
XG06G	Burglar Alarm Box	Price £12.50
XG07H	External Horn Box	Price £14.50
XG08J	Spectrum Front Panel	Price £14.95
XG09K	Train Control Case	Price £12.50
XX43W	Matinee Demonstration Cassette	Price £1.99
XX44X	Synclock Front Panel	Price £1.50
XX46A	Spectrum Joystick Panel	Price £2.25
XX47B	Train Control Front Panel	Price £3.75
XY86T	Matinee Main PCB	Price £50.00•
XY88V	Matinee Contact PCB	Price £7.30
XY90X	Spectrum Bus-bar Set	Price £2.20
XY91Y	Matinee Organ Kit	Price £299.95 Carriage extra £15.00
XY93B	Matinee Cabinet Kit	Price £99.50 Carriage extra £20.00
XY94C	Matinee Front Panel	£17.95•
XY95D	Matinee Metalwork Mounting Kit	Price £9.50•
XY96E	End Cheeks (set of 4)	Price £6.75
YK04E	Matinee PSU Bracket	Price £1.60
YK05F	Matinee Pot Mounting Bracket	Price 79p
YL26D	Guitar Tuner Front Panel	Price £1.10
YQ72P	Magnum Mode Change PCB	Price £1.65
RESISTORS		
FX87U	Thermistor KR152CW	Price 73p
SEMICONDUCTORS		
QR55K	634SS2	Price £4.95
QR56L	2SA715	Price 45p
QR57M	ML926	Price £2.45
QR58N	ML927	Price £2.45
QR59P	2SC1162	Price 45p
QY08J	74C925	Price £5.95
QY09K	LM311N 8-pin	Price 62p
QY10L	NE570	Price £4.28
QY11M	2SC2547E	Price 38p
QY12N	2SA1085E	Price 34p
QY14Q	UAA170L	Price £2.50
QY15R	2716/M2	Price £10.50
SPEAKERS		
QY13P	Piezo Transducer 27mm	Price 30p
QY16S	Rubber Disk 27mm	Price 5p
XG02C	Loudspeaker 12in. 30W TC30	Price £19.75
XG14Q	Electronic Siren	Price £19.95
SWITCHES		
BH58N	Co-ax Switch SO239	Price £6.99
BH59P	Co-ax Switch PL259	Price £6.99
FH86T	Reset Spring	Price 3p
HB60Q	Latchbracket 5-Way	Price 27p
HQ83E	Foot Microswitch	Price £3.25
HY26D	Latchbracket 16-Way	Price 72p
HY27E	Reset Bar 15-Way	Price 35p
HY28F	Latchbracket 9-Way	Price 39p
HY29G	Reset Bar 6-Way	Price 16p
HY34M	Click Key Black	Price 24p
XX45Y	Switchpot 1 pole 12 way	Price 85p
YK26D	Pedal Switch Box	Price £5.95
TEST GEAR		
YK01B	RF Frequency Meter	Price £69.95
TOOLS		
RK20W	Punch for Quick-fit Meters	Price £5.65
YK27E	Chassis Punch Set	Price £13.45
WOUND COMPONENTS		
YK02C	Transformer 2A 32-0-32V	Price £13.45
YK03D	Matinee Transformer	Price £13.75
YK07H	Transformer 4A 32-0-32V	Price £22.25
YK08J	Toroidal 30VA 0-6, 0-6V	Price £6.80
YK09K	Toroidal 30VA 0-9, 0-9V	Price £6.80
YK10L	Toroidal 30VA 0-12, 0-12V	Price £6.80
YK11M	Toroidal 30VA 0-15, 0-15V	Price £6.80
YK12N	Toroidal 30VA 0-18, 0-18V	Price £6.80
YK13P	Toroidal 50VA 0-6, 0-6V	Price £7.46
YK14Q	Toroidal 50VA 0-9, 0-9V	Price £7.46
YK15R	Toroidal 50VA 0-12, 0-12V	Price £7.46
YK16S	Toroidal 50VA 0-15, 0-15V	Price £7.46
YK17T	Toroidal 80VA 0-18, 0-18V	Price £8.35
YK18U	Toroidal 80VA 0-22, 0-22V	Price £8.35
YK19V	Toroidal 80VA 0-30, 0-30V	Price £8.35
YK20W	Toroidal 120VA 0-30, 0-30V	Price £9.57
YK21X	Toroidal 160VA 0-35, 0-35V	Price £12.28
YK22Y	Toroidal 300VA 0-35, 0-35V	Price £16.41
YK23A	Toroidal 500VA 0-35, 0-35V	Price £21.22
YK25C	12VA 15V Transformer (PCB mounting)	Price £7.49
YK28F	Transformer 12V ½A	Price £4.25

•These items are too large to be sent through the ordinary inland mail and they will therefore be despatched by carrier. Please add £6.00 towards the cost of carriage to any order containing one or more of these items.

MAPLIN NEWS

MATINEE ORGAN UPDATE

Following the 2-page section in our last issue we have now found three more possible problems. The page numbers refer to the construction book XH55K.

Page 27/28

24. If you wish the piano to re-trigger when an additional note is played, connect a 1uF 35V tantalum capacitor with its negative lead to the negative end of C179 and its positive lead via a length of wire to the unused pin 13 of IC44. See Figure 13 & 14.

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25. If your Matinée does not seem loud enough at full volume, change R582 to Min Res 220k. It is advisable only to make this change after all the modifications relating to noise previously described have been made.

26. Some constructors have noticed an audible click or thump when Wah is turned on for the first time. To eliminate this, add two resistors. One, a Min Res 470k should be connected under the pcb between the collector and emitter of TR51. See Figure 15. The second, a Min Res 100k, is connected on the top side of the pcb at S34, between the centre and back pins of the left side of section 'a'. See Figure 16.

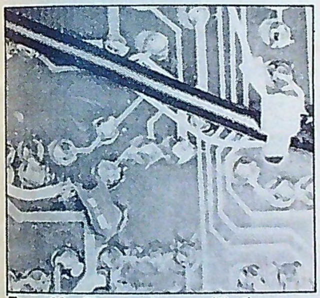


Figure 13. Piano re-trigger modification (tantalum end).

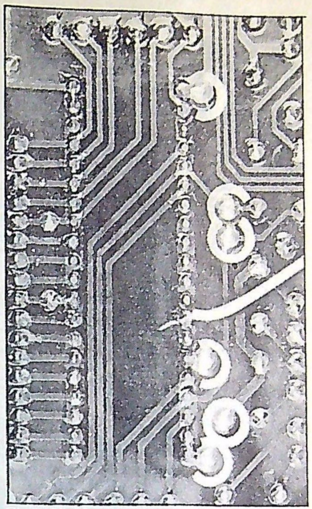


Figure 14. Piano re-trigger modification (M108 end).

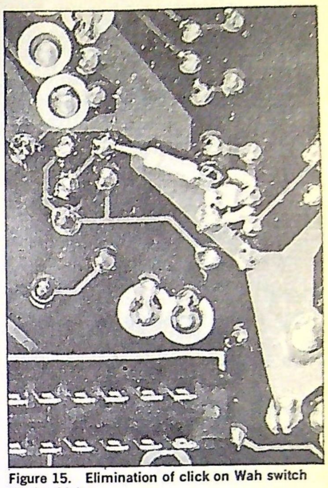


Figure 15. Elimination of click on Wah switch (underside).

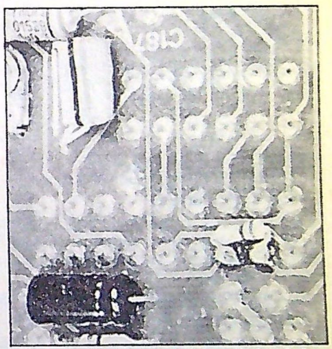


Figure 16. Elimination of click on Wah switch (topside).

QUICK-FIT METERS

Some of the technical details relating to these meters in our last issue were incorrect. The internal resistance of the following meters is as shown below:

10mA DC	5Ω
50mA DC	1.8Ω
100mA DC	0.8Ω
500mA DC	0.5Ω
1A DC	0.3Ω
5A DC	0.2Ω

Our apologies for this error.

TELEPHONE/BURGLAR ALARM CABLE

A high quality cable complying with British Telecom specification CW1293 for use in wiring telephones in customers' premises. It is also ideal for wiring contacts in burglar alarm systems. The cable contains four solid tinned annealed copper conductors each 0.5mm diameter insulated with PVC. Insulation colours are:

a-wire : blue
b-wire : orange
c-wire : green
d-wire : brown

Overall insulation is in cream PVC.
Nominal conductor area : 0.2mm²
Max working voltage : 80V
Max current per core : 0.25A
Overall diameter : 4mm

Sold per metre (max length in one piece: 250m).

Order As XR66W (4-Wire Phone Cable) Price 15p per metre

MAPLIN CATALOGUE PRICES OVERSEAS

Our current 1981/82 catalogue is available overseas by post at the following prices:

Europe surface mail	£1.68
Europe air mail	£2.75
Outside Europe surface mail	£1.68
Outside Europe air mail (depending on distance)	£3.26/£4.23/£4.88

For surface mail anywhere in the world you may send 12 International Reply Coupons.

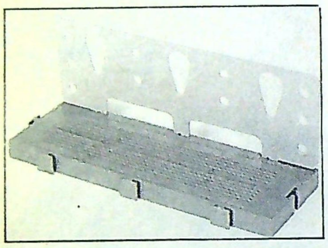
SPECIAL OFFERS

PACK OF 10 C90 CASSETTE TAPES

A good quality, low noise, high energy cassette tape in a library box. The C90 cassette gives 45 minutes recording time on each side. Incredible value. A pack of ten cassettes for only £4.95 including VAT.

Order As SP90X (Pack of 10 C90 Tapes)
Price £4.95

— OFFER CLOSES AUGUST 31ST, 1982 —

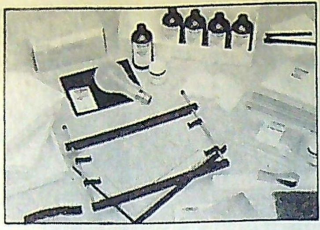


PROFESSIONAL PLUGBLOCK

Our professional plugblock described on page 144 of our current catalogue is offered until August at this big saving. Usual price £6.95. Save £2!

Order As SP91Y (Prof Plugblock) Price £4.95

— OFFER CLOSES AUGUST 31ST 1982 —



MAKE YOUR OWN PCB's KIT CM100

This superb kit contains everything you need to make your own pcb's starting from the artwork printed in the magazine or your own drawing.

Contents List

Special autopositive film
Photoflood bulb
Developer part A
Developer part B
Film fixer
Film clearing solution
3 photographic dishes
Lint-free cloth
2 pairs plastic gloves
Liquid measure
Liquid crystal thermometer
Cotton wool balls
Retouching pen
Film clips
Universal exposure and assembly frame
Photoresist
Applicator holder and foam strip
Photoresist developer concentrate crystals
6 double-sided circuit boards
Bag of copper etchant
Scouring pad
Solder flux/protective lacquer
2 1mm HSS drills
Etchant neutraliser

All the above items will be available separately later so that you can top up your kit.

As an introductory offer you can purchase the kit for £10 off our usual price.

Order As SP92A (CM100 PCB Kit)
Price £59.95

INTEREST FREE CREDIT FROM MAPLIN (APR = 0%)

Now you can get 9 months interest free credit on any order containing over £120 worth of computer hardware. Here's how it works.

In our shops:

1. Phone the branch of your choice and give them your order (must include at least £120 worth of computer hardware). We will also have to ask you some personal financial questions in order to fill up our credit application form.
2. We will phone you back within 48 hours to let you know whether your application has been approved.
3. Any time after this, you may visit the shop to collect the goods. You must bring with you some form of identification (e.g. driving licence, credit card) and sign the form that we filled in on your behalf. A deposit of 10% will be required.
4. A further 10% will be payable every month for a further 9 months equalling the total cash price for the goods.

By mail-order

1. Send your order to us (which must include at least £120 worth of computer hardware) and mark clearly on it "Interest Free Credit Terms". Enclose 10% of the value of the goods with your order.
2. We will send you by return of post, a credit application form.
3. Complete the form and post it in the stamped addressed envelope supplied.
4. When approved we immediately despatch your goods to you.
5. One month after goods despatched the first 10% payment becomes due, and thereafter a further 10% is due monthly for a further 8 months, equalling the total cash price for the goods.

Example

A VIC20 computer could be yours for just £19.99 down and £20 per month for nine months.

Don't delay

This incredible offer is only available until 31st August 1982.

MAPLIN RTX DOPPLER UNIT *(continued from page 8)*

DOPPLER MODULE PARTS LIST

Resistors — all ⅓W 5% carbon unless specified		
R1	3k9	
R2	1k (⅛W)	
R3	82k (1%)	
R4	51k (1%)	
R5	150k	
R6	4M7	
R7,17	470R	2 off
R8,11,19	10k	3 off
R9	2k2	
R10	470k	
R12,13	220k	2 off
R14	100k	
R15,16	1k	2 off
R18	220R	
R20	47k	
RV1	470k horiz sub-min preset	
Capacitors		
C1,10	100nF minidisc	2 off
C2,12	100uF 10V pc electrolytic	2 off
C3,6,9	1uF 35V tantalum	3 off
C4,7,8	100nF polycarbonate	3 off
C5	4n7 polycarbonate	
C11	10uF 35V pc electrolytic	
Semiconductors		
D1,2	1N4148	2 off
D3	1N4001	
LED1	Mini LED red	
	Mini LED clip	
TR1,2	BC548	2 off
TR3	BD139	
TR4	BC109C	
TR5	BD131	
IC1	TL430C	
IC2	uA 741C (8-pin)	
IC3	LF353	
X1	Radar module	
Miscellaneous		
	Doppler PCB	
	Veropin 2141	8 off
	Box AB7	
	Grommet small	
	Label Maplin RTX3	
	Countersunk bolt 6BA ½in	4 off
	Countersunk bolt 6BA 1in	2 off
	Washer 6BA	10 off
	Nut 6BA	10 off
	Hook-up wire	½m

See page 61 for details of interconnecting wire suitable for burglar alarms.

A complete kit is available of all the above items plus an application form for the required licence.
Order As LW73Q (RTX3 Doppler Kit) Price £39.95

CLASSIFIED

MUSICAL FOR SALE

MAPLIN 5600 stereo synthesiser, professionally built in teak case with stand, foot switch and pedal fully assembled and tested. Excellent condition, £600. Paul Hughes, 32 Brookleigh Road, Street, Somerset.

COSMOS CUSTOM organ with all extras including large cabinet, sound computer, Wersi harp, pianos, double transposer, lights, bench etc. Total cost of kits £2,200. Professionally built and as new, £2,500. Organ, piano, car considered in part exchange. Smith, Paignton 553324.

MES53 FULL scale organ not wired up. All parts to make a working instrument. Worth over £600. Will sell for £300. Phone Orpington (Kent) 30921 after 7 p.m.

3800/5600S BOARDS for sale. PSU (working), binary encoder (48 notes working), half completed keyboard controller, untested oscillator, 48 keyboard contacts, bus-bars etc. Newman, 3 Harvest Bank, Hyde Heath, Amersham, Bucks.

VORTEX KEYNOTE 600 rotary tone cabinet (Leslie type) 60 watt 2-speed. £70 o.n.o. Tel: 01-588 6107 evenings.

MATINEE ORGAN for sale. Fully built and working. £450 o.n.o. M. Nash, 33 Devon Road, Stowupland, Stowmarket. Phone Stowmarket 5487.

INTERNATIONAL 4600 synthesiser complete, tuned, all IC's in sockets. Offers to South Ockendon 853136 after 5 p.m.

ELECTRONIC PIANO — Jen J600 with sustain pedal, stand and carrying case £200 o.n.o. Tel: Derby 552776.

3800 SYNTH built and working, digital keyboard with 128-note sequencer in locking cabinet. £350 o.n.o. 22 x 22 patchboard (4600) with 60 pins £40. Ready-built modules: 2 VCO's, 2 VCA's, 2 VCF's, 1 Trans Gen, 1 Ext I/P, 1 mixer (4600), 1 joystick, all for £60 or £420 the lot. Tel: 01-679 7563.

POWERHOUSE RHYTHM unit complete with eight rhythm tapes and foot control pedal, music stand and carrying case. As new. Offers to Box No. 2, Maplin Mag, P.O. Box 3, Rayleigh, Essex SS6 8LR.

DRAWBARS WHITE. Seven 'old-type' white drawbars unused and in mint condition. £12. Phone 031-332 8377 after 6 p.m.

OFFER TO READERS constructing organs MES51 and 53 also MES55 auto organ. Complete MES53 in wooden shelves with 49-note sloped front keyboards with contacts and wired, swell and 13-note pedals, approx. 40 marbled effect keytabs, slider controls, reverb, drawbars. Constructed MES55 auto organ on shelf with switch banks, slider controls. Complete MES51 on shelf with Drumsette rhythm unit, reverb. To be sold complete or separate. MES53 & 55 — around £400. MES51 with Drumsette — around £75. Also quantity of Dressed Brazilian Mahogany to build 2 consoles. Can send. Enquiries Tel: 041-778 2555.

GUITAR ADAPTOR as in E.E. Dec. 81. £3.50 ready built & complete. See mag for details or send 25p extra for article. Reply to Dominic Loughlin, 87 Preston Road, Whittle-le-Woods, Chorley, Lancs PR6 7PG.

COMPUTERS FOR SALE

ZX81 USER-DEFINABLE graphics, create 128 extra characters (e.g. real 'Space Invaders'). Build it for under £10. Full construction and software details only £2. A. Pennell, 14 Sweyn Road, Cliftonville, Kent.

ZX81 + 16K RAM Sinclair built + 2 tapes, 3 books as new £10. Video Genie EG3003 (16K RAM) + 3 books as new £120. Phone (0702) 43911.

CESIL INTERPRETOR for 8K or 16K PETS (state which) — saves programs! Cassette — £2.50. Listings — £1. s.a.e. 12 x 9 or 30p postage. N. Stokell, 4 Beachville Street, Sunderland, Tyne & Wear SR4 7NA.

ACORN ATOM. 12K RAM, 12K ROM, PSU, leads, manual etc. had full service for sale. Excellent working condition. £240. Tel: Ashford, Kent (0233) 23077.

NEED CHEAP hard copy for your micro? How about a teletype 32ASR 75 baud printer (10 characters/sec). Excellent condition — as new, £55. Basildon 22254, around 6 p.m. best.

TELETYPE PRINTER mechanism 20mA 110 baud — noisy but working, £20. 041-942 2482.

ZX81 + 16K RAM. Sinclair tapes 1 and 4, ICL tape 5, book 30 progs, all leads and PSU. £120 o.n.o. Tel: Chelmsford (0245) 321606.

ZX81 QUALITY software — tape A: 10 1K games on cassette £2.50 or listings £3.00 includes: machine code, canyon, asteroids, shuttle, galaxians, basic, invasion, simon, connection, hangman, defender, destroyer. S.a.e. for details of tapes B & C. C.W.O. to A. Laird, 9 Franklin Road, Saltcoats, Ayrshire KA21 5AT.

EPSON MX80F/T printer. Working order as new. No defects. Looking for offers in excess of £350. L Kirby, Woolhampton Court, Woolhampton, Reading, Berks. Tel: Woolhampton 3399 on Sundays.

ZX81 SINCLAIR-built, as new, mains adaptor, leads, manual, original packaging, under guarantee, + games tape (Super Breakout). £50 o.n.o Tel 01-485 4326 evenings.

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For the next issue your advertisement must be in our hands by 7th July 1982.

VARIOUS FOR SALE

SONY STEREO microphone, one point electret condenser type in brushed aluminium case, £25. Telefunken portable radio four-waveband teak, £28. Cullman camera tripod, £35. Marshfield (022124) 574 after 6 p.m.

MAPLIN DISCO uncompleted project, assembled pcb's, power supply, power amps and other parts. Offers around £50. Chris Gilles 041-334 4154 after 5 p.m.

HI-FI TURNTABLE unit: Thorens TD150/II AB plus MC150E cartridge and spare new stylus, £38. "Ryecroft", Richards Castle, Ludlow, Shropshire SY8 4EU.

POCKET SCANNER 10 channel. Frequency coverage 150-180MHz with ten 2m crystals, rechargeable batteries and charger, as new, £40. Tel: Staffordshire 632600.

MAPLIN DIGITAL thermometer module with LCD display, three 1kW sound to light module, £7.50 each. RTVC/ETI TV sound tuner kit, built but no case, £12.50 o.n.o. Eastbourne 31200.

COMPLETE SET of 'Practical Electronics', May 1980 to February 1982 inclusive. Excellent condition. Phone (08802) 238.

CLEARING WORKSHOP. Magazines, tools, lots of new full spec components. Send s.a.e. for list to R. Hutchinson, 12 Arthur Street, West Kilbride, Ayrshire KA23 9EN.

ROYAL ENFIELD turbo twin 250cc + "On Two Wheels" motorcycling encyclopaedia. Ring Bristol 792660 after 6 p.m. - Kim.

WANTED

JVC RS-7 RECEIVER. Must be in v.g.c. Cash waiting. Medway (0634) 70214.

BEGINNER WISHES to break into radio control. Any offers of cheap secondhand equipment to J. S. Drane, 75 Abingdon Road, Bramhall, Stockport SK7 3EZ.

MAPLIN'S TOP TWENTY BOOKS

1. (1) Atari Basic Learning By Using by T. E. Rowley (WG55K) (See note).
2. (2) Z80 IC's Data Sheets (RQ54J) (Cat. P35).
3. (10) Towers' International Transistor Selector Update 2 by T. D. Towers (RR39N) (Cat. P25).
4. (9) How To Build Your Own Solid-State Oscilloscope by F. G. Rayer (XW07H) (Cat. P29).
5. (8) Power Supply Projects by R. A. Penfold (XW52G) (Cat. P29).
6. (16) Electronic Synthesiser Projects by M. K. Berry (XW68Y) (Cat. P33).
7. (15) Remote Control Projects by Owen Bishop (XW39N) (Cat. P29).
8. (14) Programming The 6502 by Rodnay Zaks (XW80B) (Cat. P35).
9. (5) Model Railway Projects by R. A. Penfold (WG60Q) (See note).
10. (3) How To Make Walkie-Talkies by F. G. Rayer (RF18U) (Cat. P30).
11. (-) Guide To Solar Electricity by Solarex Corp. (WG85G) (See note).
12. (6) IC555 Projects by E. A. Parr (LY04E) (Cat. P27).
13. (73) The Antenna Construction Handbook for Ham, CB and SWL by Rufus P. Turner (XW99H) (Cat. P30).
14. (7) CB Projects by R. A. Penfold (WG73Q) (See note).
15. (-) Byteing Deeper Into Your ZX81 by Mark Harrison (WG83E) (See note).
16. (-) Understanding Your ZX81 ROM by Dr Ian Logan (WG75S) (See note).
17. (-) ZX81 Basic Book by Robin Norman (WG74R) (See note).
18. (4) Adventures With Microelectronics by Tom Duncan (XW63T) (Cat. P24).
19. (11) Newnes Radio And Electronics Engineers' Pocket Book (RL06G) (Cat. P24).
20. (13) Programming The Z80 by Rodnay Zaks (XW72P) (Cat. P36).

Note. For prices see page 37 of this magazine. Full details of books WG55K, WG60Q and WG73Q were published in issue 1 of this magazine while details of WG85G, WG83E, WG75S and WG74R were published in issue 2.

These are our top twenty best-selling books based on mail-order and shop sales during February, March and April 1982. Our own publications and magazines are not included. We stock over 375 different books relating to electronics and the full range is shown in this magazine and on pages 23 to 37 of our 1981/2 catalogue.

AMENDMENTS TO CATALOGUE

Please amend your 1981 catalogue as follows

Page 17/18
SW46A, 47B and 48C are replaced by the UP1300/W which is a wideband amp covering the whole UHF band. The new amp gives a typical gain of 13dB and a much improved noise figure of typically 2.5dB.
SW49D is replaced by the UP1300/V which has a typical gain of 19dB and a 2.5dB noise figure.
SW50E is replaced by the PU1240 which is electrically the same as the PU102, but is in a box like YQ22Y and has co-ax sockets for both sides of the aerial lead, instead of screw terminals, making connection simpler.

Page 20
Telescopic Aerial (LB10L) now only 4ft long and slightly thicker at base.

Page 22
Mains adaptor (YB22Y) and (XX09K) are now the same item and should be ordered as (XX09K). This new adaptor will deliver 300mA max and may be switched to any of the following voltages. 3V, 4.5V, 6V, 7.5V, 9V and 12V DC.

Page 47
XY17T and XY18U are now being supplied in a smaller size. New size is 33 x 12in. (835 x 305mm)

Page 70
Electric pump XY74R is now supplied complete with a pressure gauge.
Suppressor capacitor HW02C is 1uF.

Page 93
Stereo headphone (LH85G) is now styled slightly differently from the one shown in the catalogue.

Page 104
5A Plug (HL57M) is bakelite and not nylon.

Page 107
Touch Dimmer (FQ14Q) is 250W (not 630W).

Page 115
Order codes for Slotted Nuts are WL43W (Collet Rd Nut ⅜in) and WL44X (Collet Rd Nut 10mm).
RX38R, Ebonite Rod is now being supplied in nylon.

Page 120
The DM1500D microphone is now supplied without a jack plug connected to the 5m lead.

Page 133
1mm light guide (XR56L) now being supplied with black protective sheath. Overall dia. 2.2mm.

Page 137
The spacesound units are now being supplied in slightly different sizes.

Page 154
BB67X (3600 VCF Mtg Bkt) should be included in the list under the heading "Mounting Brackets".

Page 177
The belt-drive turntable XB25C is now being supplied without an on/off switch making it suitable only for use in disco's etc.

Page 182
Please note picture of stylus 29 is incorrect. The shaft is round not square. The picture of stylus 31 is also incorrect.

Page 184
Musicentre kit C113 (LX03D) is supplied with one bottle of fluid only.

Page 186
Cassette Splicer (YW90X) is now being supplied with one reel of splicing tape.

Page 201
QH55K (MJE2955) is now being supplied as TIP2955 and QH56L (MJE3055) as TIP3055. Please note V_{CBO} is now 100V, V_{EBO} is now 7V, I_C (max) is now 15A, and the pin-out is now style P3c.

Page 229
In suggested PSU for LM383, the top end of the Std Res 100R should be connected to the collector of Q1 NOT the emitter.

Page 232
The pin-outs for the NE571 and TDA3410 are swapped over.

Page 235
The delay given by the TDA1022 is between 512us and 51.2ms and not as stated in line 2.

Page 243
In Parts List C11 is BX11M price 9p.

Page 245
The IC pin numbers in the right-hand drawing under the heading LM3911 are incorrect. The left-hand drawing is correct.

Page 255
The pin numbers on the IC package drawing under the heading L200 are in reverse order. They should be in sequence with 5 at the top and 1 at the bottom.

Page 258
QQ04E 6402 UART is now being supplied coded CDP1854ACE. These two parts are identical.

Page 266
Small Thermpath (HQ00A) is now supplied in 10g tubs.

Page 270
Crossover 2-Way (WF02C) is now physically slightly different, but it is electrically identical.

Page 276
Dual rocker neon (YR70M) requires a panel cut-out 29 x 22mm.

Page 282
Footswitch (LB64U) is supplied with a 2.5mm plug fitted to the lead.

Page 299
Crimp tool (FY31J) is improved with an additional 1mm stripper and crimpers for 1.5, 2.5, 4 and 6mm press terminals.

Page 301
Needle file set (YW63T) now contains only 10 files; there is one flat warding and one hand file, not two of each.

Page 319
The alphabetical order under S is incorrect. "Semiconductor Finder" should come after "Self-Tappers" and "Stand-offs" after "SRBP".

CORRIGENDA

The following errors in previous issues have come to our attention since the last issue was published. We offer our sincere apologies for any inconvenience caused.

Issue 1	
Page 3	In Figure 1, R70, a Min Res 100k should be shown between the wiper of RV13 and IC12 pin 3/C38.
Page 4/5	The pcb legend and Figure 7 are incorrect. The resistor marked R33 that is next to R32 should be R31. And the resistor marked R25 that is next to R27 should be R26.
Issue 2	
Page 7	On the Common pcb legend, the link next to R15 has been omitted.
Page 9	In Figure 10b, all the transistors shown, should be mounted with the metal insert upwards.
Page 12	In the Common/PSU parts list, R17 should be a Min Res 100k. This error also occurs in Figure 2 on page 4.
Page 18	In Figure 2 the battery connections should be red wire to S5, black wire to pin 2.
Pages 41/44/47	If the external horn is not loud enough make R5 on the External Horn pcb and R9 on the Main pcb into links.
Page 47	In the Main parts list, R30 should be a Min Res 100k. This error also occurs in Figure 1 on page 39.

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MPG METER: FURTHER NOTES

One or two constructors have written to us to ask for further explanation of the setting-up procedures for this project. Here, Mike Wharton explains in more detail.

Introduction

The basis of the MPG meter is to take two signals, one for fuel flow and one for speed or distance, and produce from them a digital display of 'miles per gallon'. In order to accommodate a wide variety of vehicles, the design includes a variable scaling factor. This is calculated for a particular vehicle and then set using links B1 to B8.

Calibration

To ensure that the display gives a true reading of mpg, it is obviously important that the scaling factor is correctly set and the article may not have made it entirely clear how this is achieved. The equation for calculating the factor 'n' is:—

$$\frac{8.5 \times 3000}{X \times Y} = n$$

The values which need to be known first are thus X and Y. The value of X is the division ratio of IC6, and is set by making only one of the links A1 to A7, each having the value shown in the table.

The value of '8' referred to in the article (p55) would thus be obtained by connecting Link A4.

The value of 'Y' can be obtained in one of two ways, either from the vehicle manufacturers as the number of turns of the speedo cable per mile travelled, or by using the method explained in connection with Figure 5 of the article. If the "turns per mile" figure is known then an appropriate value of Y for the formula is:—

$$Y = \frac{\text{(Turns per mile)}}{12}$$

If the value of 'Y' is to be found using the meter itself, then Link A or IC6 is first omitted and Link B1 made temporarily. This will enable the required value of 'Y' to be found according to the method described in the article.

To complete the calibration, the value of 'X' may be chosen and then 'n' calculated. This is then set, as explained in the article, using Links B1-B8 (remembering to remove B1 if it is not needed).

Naturally, changing the chosen value of 'X' will not affect the value of 'Y' (only changing the gearbox or back-axle will do that!) but will involve a re-calculation of 'n' and hence a resetting of Links B1 to B8).

Link	Value of 'X'
A1	1
A2	2
A3	4
A4	8
A5	16
A6	32
A7	64

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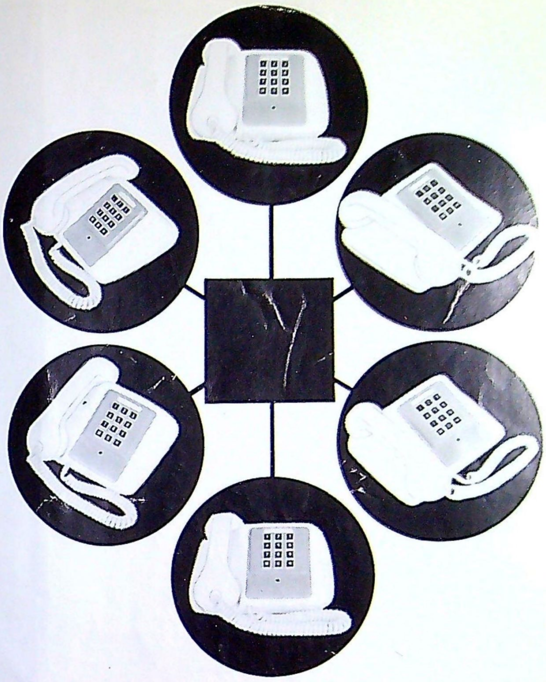

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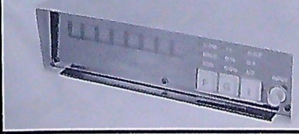

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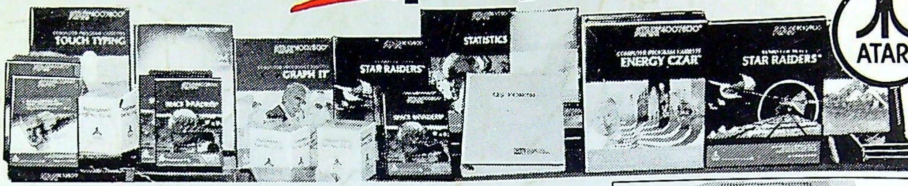

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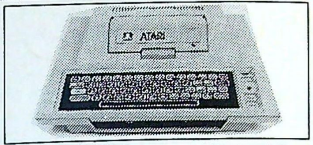

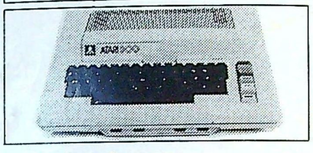

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